

CHALLENGING TEXTILES

A study of self-supporting and translucent upholstery in the field of contract textiles

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Master's thesis

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April 2013

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Acknowledgements

I want to thank

*Maarit Salolainen and Heidi Paavilainen;
Bogdan Chernyakevich;
All experts and companies who supported my
work with their knowledge and materials;
Miyu Kuno, Annethea Muller, Katarina Ginder
and many other friends and my family.*

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ABSTRACT

In my thesis I am investigating the field of contract textiles from the perspective of a textile designer. My focus is on the specific area of self-supporting upholstery for seating furniture. The research is linked to a cooperation project with the doctoral student Bogdan Chernyakevich who researches at the Aalto University Furniture Design Department. In this project a fabric for an armchair will be developed. Driven by the search for a textile material which is translucent, self-supporting and suitable for the use within public spaces, different research approaches are undertaken to support the design process. First, a background of the requirements for upholstery fabrics is provided. Second, the different possibilities and solutions are illustrated by introducing existing concepts of self-supporting upholstery within the design and industrial fields. Third, fabric samples are used to investigate in practice the selection of materials and structures. The complex interplay of materials and structures in the design of contract textiles is presented in the description of the design process and leads to conclusions and suggestions. The outcome of my thesis provides, besides a collection of textile materials, further ideas and suggestions for the development of a self-supporting upholstery to the chair design of Bogdan Chernyakevich.

I INTRODUCTION

My Master's thesis "Challenging Textiles" investigates self-supporting upholstery textiles in the field of contract textiles. The research supports an actual product development of a chair designed by Bogdan Chernyakevich who is a doctoral student at Aalto University Furniture Design Department. The concept of the chair is based on a research about optical illusions and plays in its design with the perception of curved lines from different perspectives.

The aim of my study is to research suitable textiles and to provide material suggestions for the design concept of Bogdan Chernyakevich. The purpose of the fabric in this case is not only to act as upholstery for the furniture, but to support the whole construction. Furthermore the wish of Bogdan Chernyakevich was a semi-transparent material which provides at the same time the feeling of protection and privacy.

Within this thesis I want to find answers to different questions which are linked to the design project of Bogdan Chernyakevich:

- What are the quality requirements for upholstery textiles when used for public spaces?
- What kind of textile material will provide these qualities?
- How can these materials create a translucent and self-supporting upholstery fabric ?

In order to answer these questions I have studied self-supporting textile concepts and designed a collection of fabrics. The main focus lays on the suitability of these fabrics for the use within public spaces. Textiles for public spaces require different properties which will be explained at the beginning of my thesis. This background information is followed by a description of the actual design case and process. Finally, a selection of fabric concepts and designs suggest how the upholstery fabric for the chair by Bogdan Cheryakevich could be developed.

My thesis focuses on contract upholstery fabrics, but as the textile also functions as a part of the furniture construction, the fabric needs to meet special technical requirements. In

comparison to classic upholstery textiles which are applied on a padding, self-supporting upholsteries operate without further cushioning. As a consequence their development requires a sophisticated interplay of material and structure.

In my thesis I am studying the field of contract textiles from the perspective of a textile designer. In a previous thesis on contract textiles Victoria Fislage (2012) discussed the complex relationships of different parties and the lack of knowledge transfer within the field of contract textiles. Within my thesis I rather want to elaborate on the complex development process the textile designer is facing. This work is characterized by normative requirements and technical challenges. At the same time creativity and aesthetics have to be applied within these limitations. To this little studied peculiar type of creative process my thesis offers a glimpse. The collection of samples concretises my research on the one hand and, on the other hand, provides an inspiring collection of creative ideas for the designers working with self-supporting textiles.

II SELF-SUPPORTING UPHOLSTERY FABRICS IN CONTRACT TEXTILES

1. Contract Textiles

Within my research I want to elaborate on the special features of self-supporting upholstery fabrics which conform to the quality requirements of contract textiles. Following the definitions of the terms contract textiles and self-supporting upholstery will be a discussion on quality requirements and standards for upholstery fabrics.





picture 2 - Residential living room (interlückbe)



picture 3 - Hotel lobby (verticallaunch)

1.1 Definition: Contract Textiles

Contract textiles refer to a special group of fabrics which are produced and sold for commercial interiors (ACT: Association for Contract Textiles, n.d.). It is important to distinguish between textiles for residential use and those used in public spaces, like hotels, theatres, airplanes and ships. The reason for this is that while in residential textiles design and durability are the main considerations, the public sector has to additionally focus on higher demands of safety and durability.

The applications of contract textiles mainly include interior fabrics like carpets, bed linen and upholstery. Compared to the private household use, these textiles have to withstand

tougher environmental conditions like more frequent usage, more dirt and an increased need for cleaning. For this reason contract textiles have to fulfil higher quality standards than other textiles and have to prove that they will meet these high demands. As a consequence it is of utmost importance that the purpose and location for which and where a material will be used is known prior and during the manufacturing of the textiles.

1.2 Definition: Self-Supporting Fabrics

By definition the term self-supporting describes that an object is able to stay “up or upright without being supported by something else” (Stevenson and Lindberg, 2010)

Self-supporting textiles are characterised by their strong resilience, which means that they are elastic to a certain degree and able to return to their original size after stretching. Furthermore these textiles provide a certain level of stiffness. Compared to a hammock which changes shape while being able to sustain the weight of a person, a self-supporting textile will keep the same or almost the same shape independent of whether weight is transferred to it or not.

Unlike solid materials like wood or stone, a self-supporting textile always withholds a certain level of elasticity, which results in both softness and comfort. Most textiles though are not self-supporting in and off themselves, but by adjusting them to a frame with a high tension for example, they can create a supporting effect. In that way fabrics can for example serve as space dividers or light alternatives of upholstery (Gabriel A/S, n.d.). Office chairs are one example of a widespread furniture which uses this effect, with the backrest usually being constructed by a frame and a self-supporting textile. Through this unique combination of a softening and at the same time stabilizing effect, self-supporting textiles offer an interesting alternative to regular upholstered furniture.

For the selection of the appropriate fabric it is important to note that not all textiles can work as a self-supporting material when stretched over a frame. Some textile materials would most likely lose their shape over time. This shows that dimension stability is an important criteria when selecting self-supporting fabrics.

Essentially a strong textile material with high tensile strength would be optimal for this purpose in combination with the right processing. A common rule of thumb is that the stronger the yarn, the stronger the final textile will be. There are however other influencing factors. The structure of the material also influences the behaviour of the fabric. For example, the point where the fabric breaks, differs between a fabric with an elastic and one with a non-elastic structure (Booth, 1968). Considering the complexity and the multiple properties required to obtain a self-supporting textile, great care should be taken in searching for the right material and in deciding on an appropriate processing method.



*picture 4 -
Office chairs with
self-supporting
upholstery
(dynamobel)*

2. Requirements for Upholstery Fabrics

In addition to the requirements for the design of a self-supporting fabric, the general demands for upholstery fabrics and especially contract textiles also have to be considered. In order to guarantee that these textiles are able to meet the specific needs for public use, certain standards have been developed. Within the European Union there is a norm canon called EN which handles the requirements for textile materials. (CEN European Committee for Standardization, n.d.)

Regarding upholstery fabrics the standards are stated within EN 14465:2003:

“This standard specifies a set of properties relevant to the assessment of upholstery fabrics for indoor furniture and the appropriate test methods to determine these properties. It also describes a matrix system to express the material properties of an upholstery fabric. This standard applies to upholstery fabrics both in domestic and public use, except when used for the seats of road or railway vehicles, boats or aeroplanes. This standard does not apply to upholstery fabrics with a coating on the wear face.” (CEN European Committee for Standardization, 2003)

The most commonly used standards for contract textiles are the following: EN ISO 105-B02 colour fastness, EN ISO 105-X12 colour fastness to rubbing, EN ISO 12945-2 pilling tested by Martindale method, EN ISO 12947-2 abrasion resistance by

picture 5 - Upholstery fabric (Nya Nordiska)





picture 6 - Upholstered furniture (brühl & sippold)

Martindale method, and EN ISO 13936-2 for seam slippage. In addition EN 1021 parts one and two describe the burning behaviour of upholstered textiles. (CEN European Committee for Standardization, n.d.; Suomen standardisoimisliitto, 2009) Due to the fact that these standards serve as general guidelines for all kind of textiles, it is important to understand their specific meaning for contract textiles. All of the norms contain a rating system based on grades or a pass, failure result. For contract textiles the ranking is aimed to be higher than that for residential used textiles. Nevertheless, the quality of a contract textile should be appropriate to its final use. These standards will be explained in more detail below.

2.1 Flame Retardancy

Fire safety is one of the most important quality criteria to be considered in relation to contract textiles. Within public spaces all used textile materials have to fulfil specific safety requirements which will result in the fabric burning very slowly and preventing the spreading of fire. Horrocks and Price (2001) state in their book *Fire retardant materials* that the major cause of fires are textile materials and as a result standards have been defined in order to reduce this risk.

Flame retardancy can be enhanced through various processes. Firstly, the fibre itself can contain fire retardant properties in its original texture, with wool being an example. Secondly, chemical add-ons during the production process of fibres allow to create permanent fire retardant properties. Thirdly,

a finishing process involving the treatment with chemicals can add flame retardant qualities to a textile material. This is not durable compared to the other methods and has to be renewed regularly. For that reason it can not be recommended as flame retardancy enhancement for contract textiles.

Most upholstery textiles which are sold within the European Union for use in residential and public spaces should fulfil a fire safety standard. Two widespread norms are EN 1021-1 and EN 1021-2. Within this standard the burning behaviour of upholstery textiles is tested. In order to simulate a burning scenario the first part, EN 1021-1, tests what kind of damage a glowing cigarette would induce. This test method is valid for all upholstery textiles. The second part, EN 1021-2 which



is a test with an open flame, is an additional test for contract upholstery. In both methods a furniture model is upholstered with the textile which is tested. The dummy consists of a seat and a backrest part which are attached at a 90° angle. In case of EN 1021-1 a glowing cigarette is placed at the point where seat and backrest connect. In order to pass the test, the textile should not start burning during this process. (Suomen standardisoimisliitto, 2010a) For additional testing (EN 1021-2), an open flame, simulating a burning match, is placed at the connection of the backrest and seat. Similarly within this test, no further burning of the upholstery should occur. (SP Technical Research Institut of Sweden, n.d.)

The quality information of a fabric states whether the standard

has been fulfilled. Even though these standards are valid within the Europe Union, some countries might require only part one of the standard for certain public spaces, whereas others demand both parts or even additional tests (Kvadrat A/S, n.d.). In general the EN 1021-1/-2 standard is the European wide valid norm and should be followed. For that reason the EN norm can be seen as a guideline, but the distinct local conditions have to be met.

picture 8 -

Fire retardant textiles prevent spreading of fire (left curtain); Other textiles instead burn heavily (right curtain) (Trevira)



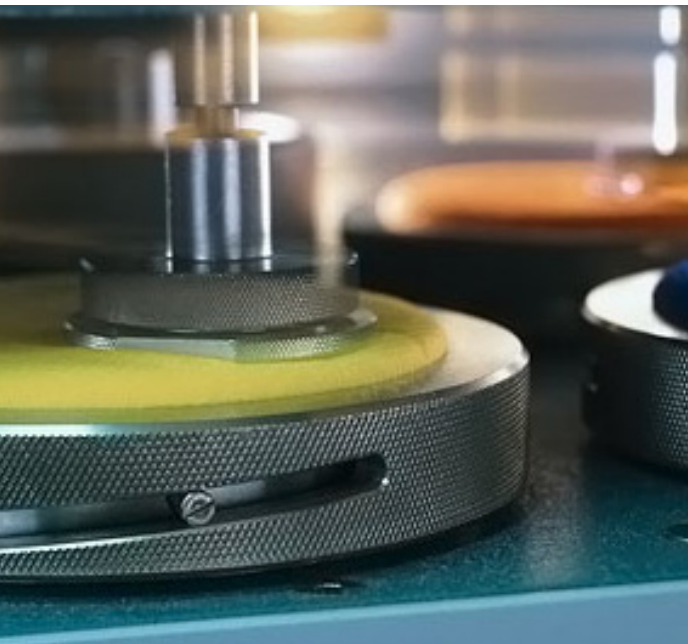
2.2 Abrasion Resistance

Abrasion resistance describes the durability of a fabric when two textile surfaces rub against one another. For an upholstery fabric one of the highest demands is to withstand the impact of frequent surface rubbing. One example is the clothes of the user rubbing on the surface. Depending on how regularly a piece of furniture is used, the upholstery has to withstand more or less stress. To simulate this, there are two testing methods, Martindale and Wyzenbeeck (ACT: Association for Contract Textiles, n.d.). Both tests simulate a constant rubbing across the surface of the textile. While the Wyzenbeeck test is the preferred method within the United States of America, the Martindale method is commonly used inside the European Union. For this reason only the Martindale test method, which

is defined by the EN ISO 12947-2, will be described here in more detail.

In order to test the abrasion resistance, the fabric is placed in an apparatus, called the Martindale abrasion testing machine. This machine rubs pieces of the testing fabric against another standard fabric under a defined weight. The movements are conducted by elliptical rounds to simulate the later rubbing movement. The test runs until the fabric breaks or the maximal abrasion movements of 100.000 cycles are reached. (Suomen standardisoimisliitto, 2009)

The result of the test is generally provided within the quality information of the textile. Cycle values above 30.000 rubs can be seen as favourable for the high demand put on contract textiles. It should be noted that these values represent a simulation of material behaviour in laboratory conditions whereas in reality there may be some deviations. Therefore it is important for the selection and assessment of the fabric to understand these test results. Generally the assumption that a higher rub value shows a better resistance of the fabric against abrasion is correct, but it can not be taken as the sole quality criteria (ACT: Association for Contract Textiles, n.d.).



*picture 9 - Martindale abrasion test machine
(W. L. Gore & Associates GmbH)*

2.3 Pilling



picture 10 - Pills on a fabric (studyblue)

Besides the abrasion resistance, pilling also plays an important role in the testing standards for upholstery fabrics. Pilling occurs when loose fibre parts stick to intact fibres on top of the fabric and causing an unattractive look. Often these fibre balls originate from the same textile, but they also can mix with foreign fibres, leading to a colour change of the original fabric. (Booth, 1968) To avoid this, an upholstery material should be tested for its pilling properties.

To simulate a possible pilling behaviour, samples of the upholstery fabrics are tested, similar to abrasion resistance, by the Martindale method. The standard EN ISO 12945-2 explains the testing method and the grading system.

Test samples are rubbed against a woollen fabric. In periods of 500, 1000, 2000 and 5000 rubs they are examined and graded. If the test fabric shows no difference to the original the grade five is given. The scale from five to one is equal to an increase of pills on top of the test piece. The final result is formed by the average of all given grades. (Suomen standardisoimisliitto, 2009) Among contract textiles the results are aimed to be high and usually a grade of four to five is reached.

To conclude the surface wear standards, the end use of the fabric will dominate what grades are required. For instance the upholstery for rarely used luxury hotel furniture could meet a lower standard compared to a restaurant furniture in constant use.

2.4 Colour Fastness to Light

After the surface testing of a fabric, the behaviour of the colour is also an important criteria for the selection of upholstery textiles. What all textiles have in common is that they will change colour over time. Depending on factors such as fibres, dyes and finishing processes, some textile colours may fade or change faster than others. For contract textiles this phenomenon is of special importance. These textiles are mostly used for long periods of time and refurnishing or exchanging upholstery is costly. If for example parts of upholstered furniture are more exposed to natural light than others, a great colour change can be the result. To avoid this, the standard EN ISO 105-B02 handles testing methods for colour fastness to light.

A piece of the testing fabric and eight reference pieces of blue wool fabric are placed to a light source for a certain amount of time. For the evaluation of the test, the testing sample is compared to the blue reference swatches. The final grading for the colour fastness is defined after the reference number to which it is the closest. For example a fabric fading similar to the blue reference sample number three, the grade three is given. (Suomen standardisoimisliitto, 2010b) For contract upholstery, a result above the grade five is common. The end use of the textile determines the requirements of the light fastness. For example, upholstery fabrics which are used in a closed room like a concert hall could operate with a lower result of this standard. Whereas frequent exposure to daylight in for example a public winter garden, the furnishing would require a much higher result. To obtain durable solutions, the chosen textile should withstand the required conditions.



2.5 Colour Fastness to Rubbing



picture 11 - Coloured textiles have to withstand various impacts(Nya Nordiska)

In addition to the colour fastness to light, another colour standard important for upholstery textiles is fastness to rubbing. The surface of an upholstery fabric is in frequent contact with other textiles, such as clothes. Through rubbing it could happen that the coloured upholstery stains the other materials. To prevent this, a test method, defined by the norm EN ISO 105-X12, simulates this scenario.

A test machine consists of a rubbing device which moves under a certain force over the testing fabric in a linear, repeatable manner. For dry rubbing, a standard textile is attached to the testing machine and rubs 20 times over the testing fabric. After that the standard fabric is compared to an original version which was not rubbed. The colour change between both textiles is compared to a grey scale reference. These references are numbered from one to five. Five indicates that the colourfastness to rubbing is very good, because no noticeable colour change on the standard fabric occurs. A grading one indicates a low colour fastness, due to a high colour change of the rubbing cloth in comparison with the original.

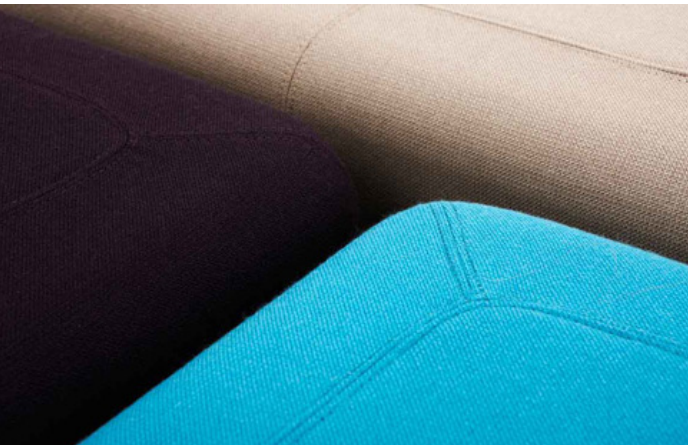
A further test under wet conditions is conducted in the same manner, but uses a wet standard fabric. This simulates the situation when a cloth is damped by sweat. (Suomen standardisoimisliitto, 2010b) The colours of many fibres more easily fade under wet conditions, especially in the case of natural fibres. For this reason, the colour fastness to wet rubbing is an important quality attribute. As the staining of a textile by an upholstery fabric is never acceptable, contract textiles especially have to fulfil this quality demand at a high level.

2.6 Seam Slippage

Next to the already mentioned standards, special attention is also given to seam slippage. This applies only to woven textiles, but as most upholstery fabrics are woven, it is an important quality criterion. Seam slippage occurs when force is applied to a textile and the weft or warp yarns next to the seam slide from their original position. As a result, an opening alongside the seam can be noticed. (Suomen standardisoimisliitto, 2009) For example at the edges of a piece of furniture, where the seam has to fulfil a functional role, it is important that the fabric is able to withstand great forces. Self-supporting upholstery in particular has to carry high loads. In that case no cushioning or other materials will bear the weight of the user, so the textile needs to provide a strong base for the seam.

In general, seam slippage is most likely to happen in woven fabrics with low density. In contrast, a close binding structure decreases the effect. (Booth, 1968)

The standard EN ISO 13936 describes two different methods to test the seam slippage of a fabric. Both tests stretch a sample fabric, which contains a seam, in an apparatus to a certain extent. Depending on the method, the test pieces are evaluated after predefined dimensions of the seam opening or after set force values. In both cases the relation between applied force and seam opening is reported. (Suomen standardisoimisliitto, 2009) The smaller the opening appears when stretched at a high force, the better is the behaviour of the fabric regarding seam slippage.



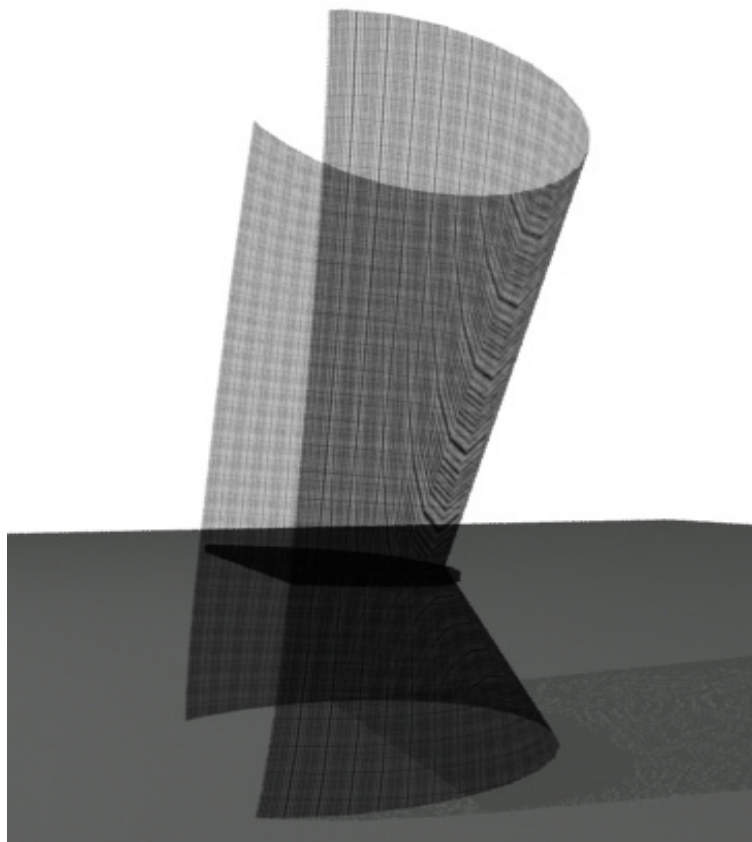
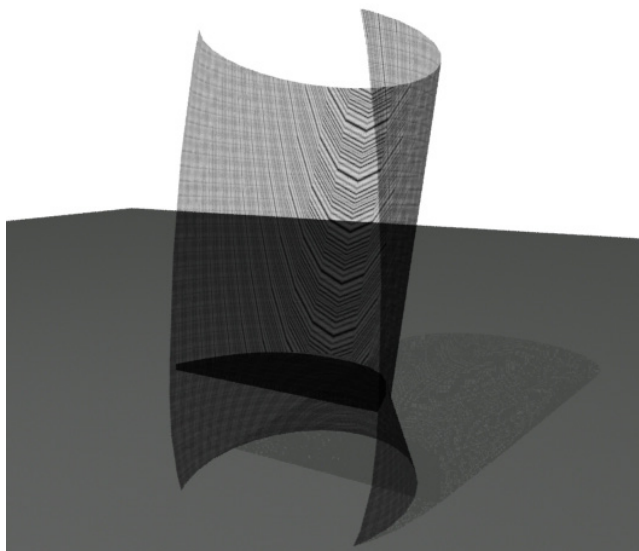
*picture 12 & 13 -
Dense binding structures
prevent seam slippage
(Normann Copenhagen)*

III DESIGN CASE

Following the exploration of quality requirements of contract upholstery fabrics outlined so far, I will concentrate next on my practical research related to self-supporting textiles. This study is based on the furniture design idea of Bogdan Chernyakevich. In this cooperative project the focus was to investigate possibilities for an upholstery fabric. In order to gain a broader perspective a desktop research complemented the practical material studies. For the theoretic part the focus was on existing textile concepts in the field of furniture design which were related to the design idea of Bogdan Chernyakevich. In addition to these inspirations the research among contract textile manufactures also revealed important information about materials and requirements for self-supporting upholsteries. All these findings inspired and influenced my design work. In the following I will explain the design concept, give examples of existing furniture concepts and describe my design process.

1. Design Concept

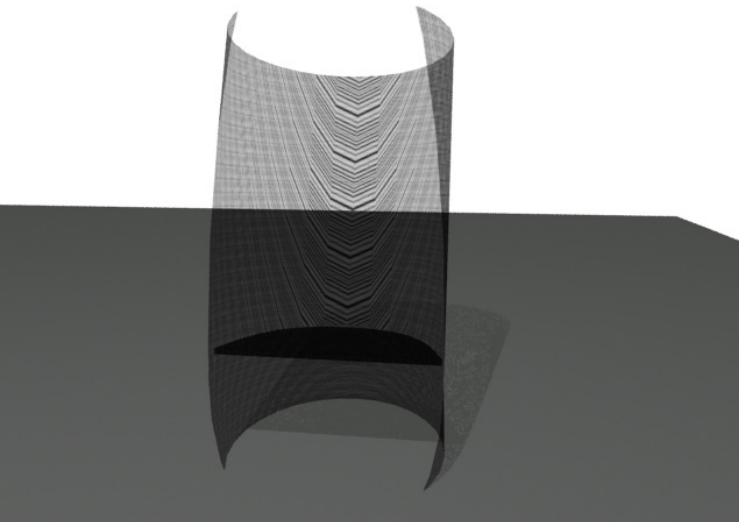
The playfulness of optical illusions is one of the main arguments within the studies of Bogdan Chernyakevich. The phenomenon of our perception to interpret the same content differently, depending on the particular point of view, is the central idea behind his furniture concept. As my own design work is linked to this concept, it builds upon the idea of optical illusions. In this way furniture and textile upholstery can support one another.



1.1 Cooperation Project

While Bogdan Chernyakevich develops an armchair design as practical application for his research, my design study concentrates on the possible designs of the upholstery fabric for this chair. The upholstery plays a major role in the design concept as a whole and besides just an upholstery role, it also serves a constructional purpose. Therefore, a cooperation between furniture and textile design offered the possibility to inspire and support each of our works.

*pictures 14, 15 & 16 -
Chair illustration by
Bogdan Chernyakevich*



1.2 Furniture Concept

The furniture is based on optical illusions of curved and straight lines within the space. The shape of the chair is formed by the connection of two cylinders which are merged together. The front side of the chair is formed by cutting away one section of the object. A hollow body finally builds the basic constructional idea.

In its complexity the outlines of the chair appear very different to the user. As the user walks past the object, the perception of these lines change from straight to curved or vice versa. In addition to that the size of the chair also supports the visual concept. A two meter high backrest fully encloses the person who sits on the chair. The backrest continues from the seat to the bottom of the chair and thus functions in this way as a base. This nook design which would offer privacy is transformed by the concept of the material. To support the playfulness of optical illusions, the material from which the chair is constructed has to be light and translucent. The choice of a textile material provides in this way the possibility to see through the fabric to the inside of the chair. Beside this contradictory element, the upholstery also has to provide sufficient support to the entire chair construction. Because the fabric is attached to a metal frame both elements have to be able to bear the load of a person sitting in the chair.

1.3 Fabric Concept

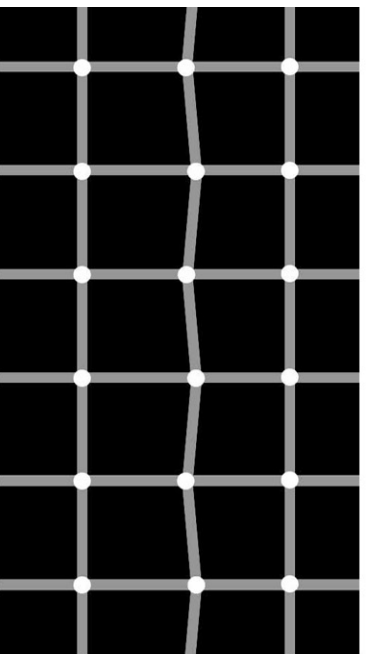
As a consequence of the furniture concept, the key words of *translucence* and *optical illusions* already set the base for the conceptual ideas of the fabric. The aspect of translucence is defined for materials which “allowing light, but not detailed shapes, to pass through” (Dictionaries, 2010). Within self-supporting upholstery, light and translucence characteristics are unique since upholsteries tend to be made from dense and heavy textiles. Therefore, the decision of designing a self-supporting upholstery unifies the translucent quality with stability.

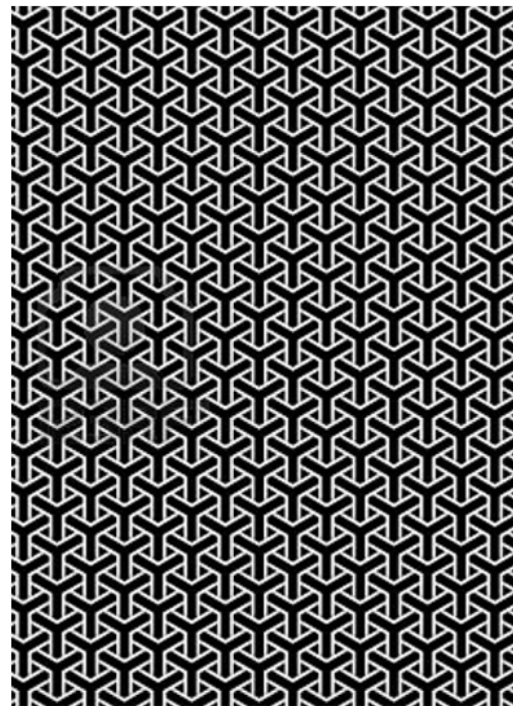
In addition to the inspiration of a light fabric, the playfulness with optical tricks also influenced my fabric concept. The idea was to embed this *playing* with the perception in a subtle way by using patterns with a high contrast of light and dark. Usually within textile patterns it is favoured to avoid contrasts between light and dark which are too high in order to gain an even and pleasant look. It can happen very easily that the pattern will start to flicker and confuse the eye. In awareness of this effect, a prominent idea in my pattern design was to test how far the *playing* with black and white could create an attractive surface.

In order to achieve a calming effect, a clear and geometrical style was chosen. This was mainly based on inspirations from architectural structures and graphical Japanese black and white patterns. Even though my pattern design validates further exploration, the fabric as a whole should provide a relaxing and calming atmosphere.

Beside the visual ideas for the fabric concept, the constructional part represented the greatest challenge. The selection of the right material to be suitable as contract upholstery and as self-supporting fabric influenced the whole fabric to a great extent. For this reason many test samples used to observe material and structure were produced. The final goal was to combine the technical parameters with the visual concept in the production of an appealing fabric design.

mood board 1







2. Existing Furniture Concepts

Within the design process a first step was the research of already existing textile design concepts regarding the use of self-supporting textiles for chairs. As textiles are a very old medium and have been used over many centuries as upholsteries for seating furniture, it is interesting to note that they are still part of innovative design solutions (Hubbell, 2012). Already at the beginning of the 20th century self-supporting textiles formed a part of the furniture design, especially within the minimalistic Bauhaus designs. A famous example is the *Wassily* chair by Marcel Breuer which was constructed from the combination of bend tubular steel and fabric. (Morteo, 2009) Even as it seems that contemporary furniture design focuses more on even and plain surfaces by using solid materials like wood, metal or plastic, a couple of designers still investigate textile materials and their potential for furniture applications (Hubbell, 2012). Especially the total reduction to construct furniture entirely from textile materials

is now a major interest. The term of “Fibre Furniture” (Quinn, 2010, p.184) describes these contemporary developments where modern fibre technologies are used. Quinn (2010) explains this interest of furniture designers as an emerging trend which started in Europe at the beginning of the twenty-first century. The combination of new technologies and materials with traditional textile handicrafts forms a central part of this design approach (Quinn, 2010). Furthermore, design concepts of translucent chairs astonish through their airy appearance while they at the same time offer a firm functionality.

All of these ideas share the characteristic that textile materials or technology are a fundamental part of the design. Below some examples will be discussed in more detail.



picture 17 - *The Knotted Chair* by Marcel Wanders
(marcelwanders)

2.1 The Knotted Chair

One technical method to convert soft textile materials into solid ones is the use of stiffening resins, like the design of the *Knotted Chair* by Marcel Wanders shows. Twisted aramid and carbon threads build the grid of the chair which is then treated with an epoxy resin. The final form of the chair is created during the drying process while the net-like textile is spun into a frame. At the end of the process the knotted carbon and aramid threads form a stiff and self-supporting lightweight chair (Wanders, 2013; Quinn, 2010). In contrast to the classical steel frame design, the fully textile constructed chair of Marcel Wanders reveals the potential and beauty of modern textile materials. Furthermore it displays the reinvention of old handicraft technologies like macramé in combination with high-tech materials and treatments.

2.2 The NETwork Chair

Another chair design which uses resins as a hardening material is the *NETwork Chair* by Studio Aisslinger. The chair is formed by a lace-like textile net which is soaked into a resin. To shape the final form, the wet textile net is draped over a mould and it dries and hardens there. Finally, a very light and fragile looking chair is the result (pleatfarm, 2010). Also in this concept the basic idea originates from an old handicraft technique called lace making. Through warp knitting this technique can be produced mechanically and enables the play of light and stable furniture through a further finishing process.



picture 18 - The NETwork Chair by Studio Aisslinger
(Werner Aisslinger)



picture 19 - The Textile Moulded Chair by Joscha Brose
(Studio Hausen)

2.3 The Textile Moulded Chair

In comparison to these design concepts a more solid design idea, based on the form of corals, is introduced by Studio Hausen. With the *Textile Moulded Chair* a different approach is achieved to construct a self-supporting upholstery. Here a hardening polyurethane foam instead of a resin takes the role of the supporting element. Into a textile cover fluid polyurethane is inserted which hardens and fills up the space inside of the textile. (Studio Hausen, 2013) As a consequence the chair looks more solid and bold than its original material might actually be.

To summarize, all of these examples display the possibility to construct chairs out of textile materials and at the same time gain self-supporting properties. In contrast to these ideas, the furniture of Bogdan Chernyakevich should offer a soft surface and for this reason a hardening resin would not offer an appropriate solution.

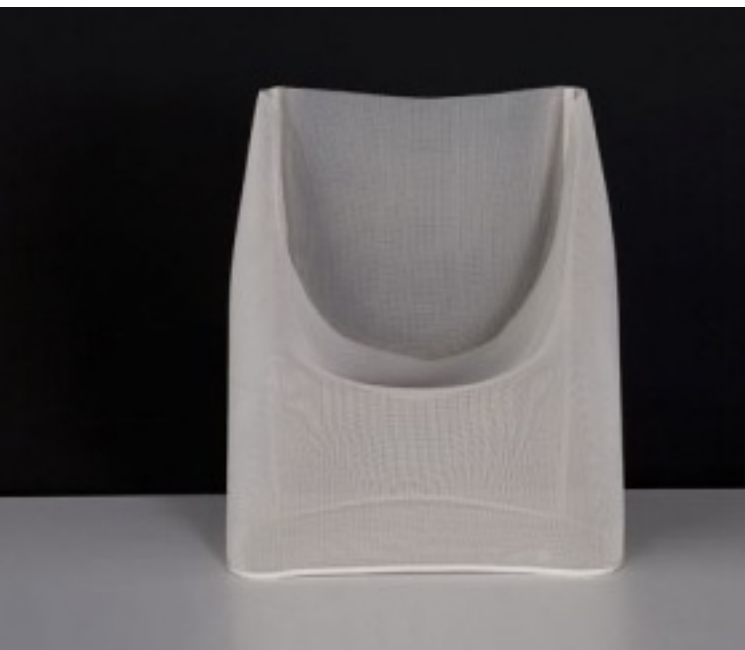
2.4 The Stiletto Chair

Besides the stiff effect of resins or other synthetic materials, elastic materials which could bear high loads were also of major interest. The contradiction between stability and elasticity offers an interesting aspect. My research has revealed the possibility of a fabric to assume a certain shape due to elasticity, and to provide supporting strength at the same time. My focus was especially on chairs which use this effect of elastic and self-supporting upholstery.

An elegant example can be found in the design concept of the *Stiletto Chair* by Magdalena Ekström. The idea is based on a minimalistic concept by using only a nylon net fabric which is attached to a metal frame. Without any cushioning foams or other stabilizing elements, only through the high tension of the fabric, it supports the person sitting at the chair. Due to the high elasticity of the nylon, the chair offers comfort without any other upholstery parts (Ekström, n.d.). Furthermore, the fine net structure and the thin nylon create a translucent and light appearance. This combination of elasticity and translucence offered also great potential for the upholstery design of Bogdan Chernyakevich.



picture 20 - The Stiletto Chair by Magdalena Ekström
(madeinschool)



picture 21 - The Net Chair by Tomek Rygalik
(bonluxat)

2.5 The Net Chair

A different material concept can be found in the design of the *Net Chair* by Tomek Rygalik. Even though the furniture seems to be light and translucent, it is made entirely from metal. In contrast to the *Stiletto Chair*, Rygalik does not work with textile material, but uses weaving technology. The *Net Chair* is build by two pieces of woven steel which are fixated by a finishing treatment. Here the solid material steel gives the supporting properties and shapes the form of the chair (Bonluxat, n.d.). Despite the fact that the material is very solid and heavy, the chair appears as soft and light as if woven from a textile material.

All of these examples show the high potential which textile technologies and materials offer for furniture designs. Inspired by this, the objective of my study was to find a suitable solution which fits the needs of the chair design of Bogdan Chernyakevich.

3. Design Process

The aim of my design process was to explore different materials and structures which would meet the requirements of the fabric concept. As the research of existing self-supporting fabrics and furniture designs showed multiple methods already exist. This meant, for my design process, to start from a broad pool of ideas and then to narrow down few final solutions.

My process contained steps of producing test samples, discussing the outcome and selecting the most promising ideas. After that the process of prototyping, discussing and selecting started again on the basis of the previous experiences. Even though the process can be defined clearly, the development process did not follow a clear linear path. Rather, a cyclical path helps to express the trial and error characteristic of my design process.

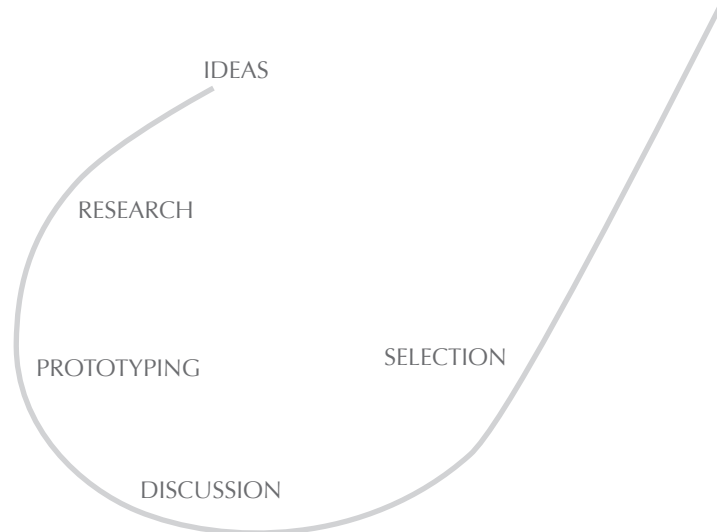
Several key questions guided my work:

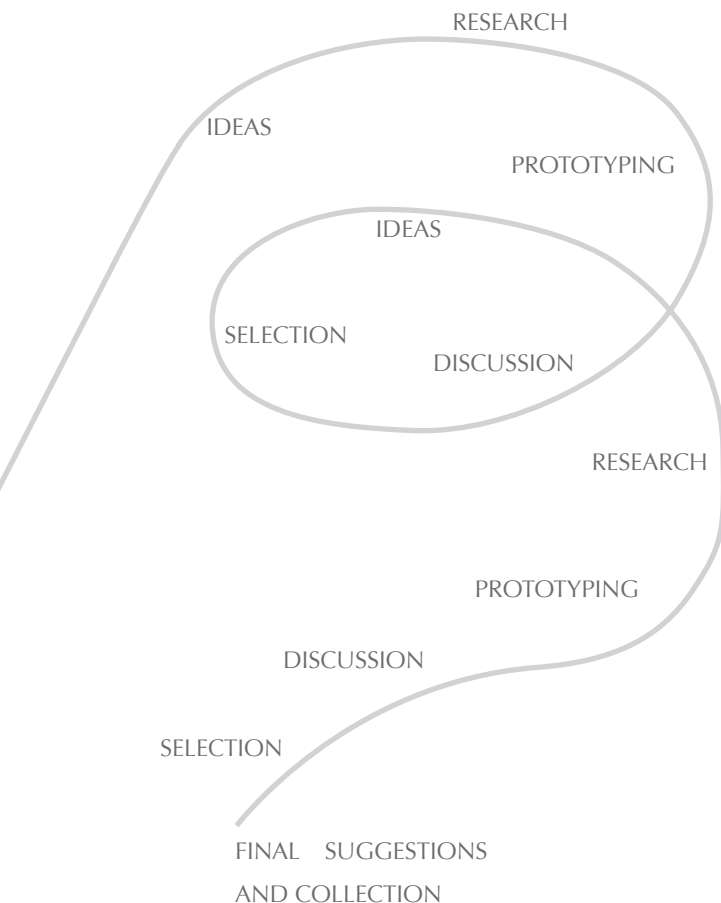
- How to achieve a self-supporting textile?
- How to create translucence within the fabric?
- In which way can the fabric meet the requirements for upholstery within public spaces?

These questions were constantly at the forefront during the process phases of prototyping, discussion and selection.

Prototyping

With the production of prototypes I explored the behaviour of different materials and structures. In order to gather this information I produced a set of sample fabrics at the weaving and knitting studios at the Aalto University Department of Design. I produced mainly small size swatches, to enable a first investigation into the behaviour of the textile. Usually these small samples cannot guarantee a valid prediction about the real behaviour of the one to one sized material. Nevertheless, they provide, like first sketches, a better imagination about possible fabric solutions and supported my decision making process. A collection of final fabric samples shows the results of this experimental research.





Discussion

In order to evaluate the produced test sample it was important to constructively discuss about them. This phase included several conversations with my supervisor to get feedback about the outcome of my prototypes. Furthermore the discussion phase was also based on the literature research and the study of existing fabric concepts. The gathered information worked as reference to see the compatibility of my own design with the key questions. Also the criteria of self-supporting and translucent properties in combination with the quality requirements of contract textiles formed the centre point of the discussion process.

Selection

Each discussion provided a selection of ideas which had been seen as interesting and promising to investigate further. Another phase of prototyping followed and the discussion and selection processes had to start again based on the new outcomes. This cycle continued until I reached a small selection of materials and structures.

3.1 Choice of Materials and Structures

Since the concept of my fabric design required a careful selection of the right materials and the suitable structures, the search for those was the main part of my design process. Starting with a huge variety of material ideas it was important to narrow the selection down to the most promising ones through constant research, testing and selection. The same applied to the selection of the technology and much more to the final structures. In order to understand the complex selection process for the development of a self-supporting contract upholstery fabric it is important to have access to some basic information about materials and structures.

Materials

The raw material of textiles are fibres which are grouped into either *natural* or *man-made fibres*, based on their different origins. *Natural fibres* as the word already indicates, describe those fibres which are extracted from natural origin like plants or animals. On the other hand the term *man-made fibres* encompasses all materials which are produced by a chemical process, mainly split into the groups of regenerated and synthetic fibres. (Jindal, 2007)



picture 22 & 23 -
Textile fibres and structures
(picture 22: Trevira)



Natural fibres

All natural fibres which are produced from vegetable origin are characterized by their basic element cellulose. Similar to wood, which also has a structure based on cellulose, these vegetable fibres burn easily. Therefore fire-retardant properties could only be added through a certain chemical impregnation which would not provide a durable effect and therefore they are mostly neglected in the development of contract upholstery. (Jindal, 2007; Horrocks and Price, 2001) In contrast to vegetable fibres, for example, the protein-based wool is known for its fire-retardant qualities and self-extinguishing properties. For this reason many contract textiles are made out of wool. Furthermore these fibres have, compared to cotton, a much higher elasticity, but their tensile strength is quite low. Despite the fact that wool is often used for contract upholstery textiles, an application for self-supporting fabrics can not be recommended, because of its weak tenacity. (Hibbert, 2004; Jindal, 2007) Due to these properties the whole section of natural fibres was not taken into consideration during my design process.

*picture 24 & 25 -
Natural fibres such as cotton and wool
(picture 24: pastimesonline;
picture 25: eveanders)*

Synthetic fibres

The group of man-made fibres offered much higher potential as it is possible to manipulate certain quality requirements of the fibres, like fire retardancy for example. Materials with a good performance for the high demands of self-supporting contract textiles can be found among the group of synthetic fibres.

Different types of synthetic fibres exist and these can be further categorized into six groups of polyamides, polyesters, polyvinyl derivatives, polyolefins, polyurethanes and other synthetics, like glass, carbon and metal. They are essentially named after their chemical structures and they are produced as blend yarns or pure. (Jindal, 2007) All these synthetic fibres have in common that they are dimension stable, resistant to moths and mildew, and offer a high durability (Quinn, 1985). It is not easy to compare and find valid advantageous or disadvantageous among the synthetic fibres, due to the fact that during the production process many factors like tensile strength, pilling resistance and flammability, to name only few, can be adjusted (Militký, 1991; Recytex GmbH & Co. KG, n.d.). Most likely, depending on the specific purpose of the final textile, the yarn can be adjusted to a certain amount. As a consequence it is useful to get in contact with specialized yarn manufacturers in order to discuss specific needs.



*picture 26 & 27 -
Synthetic yarns and fibres
(americhem)*

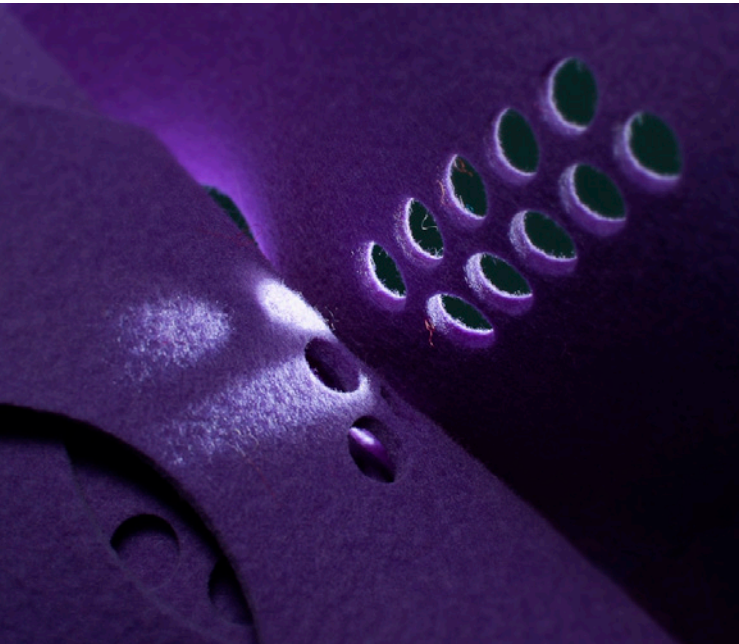
Structures

In deciding on the right structure it is also important to understand the influences of different manufacturing processes for self-supporting contract fabrics. The textile production techniques can be categorized into weaving, knitting and non-woven.

Non-woven

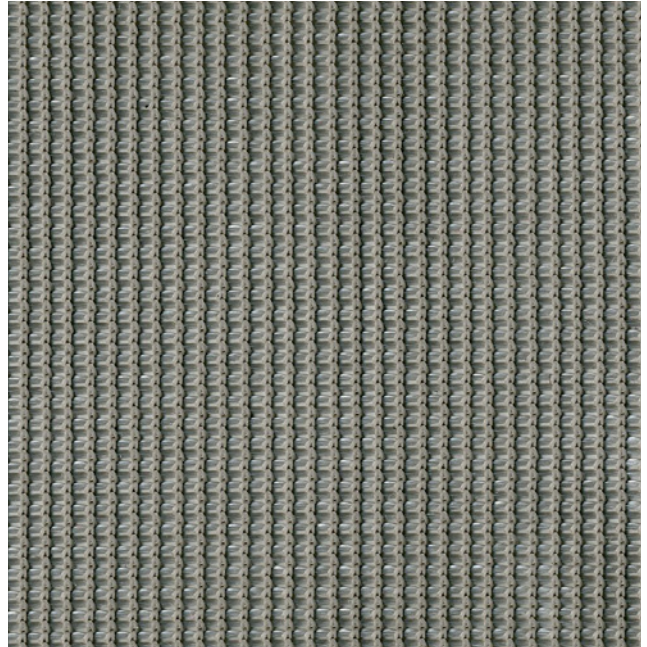
The great advantage of non-woven fabrics is that they are produced directly from fibres which diminishes the need for a separate processing of yarns and results in a fast and cheap production process. Through physical and chemical procedures the loose fibres are connected and tend to build a solid textile. Various methods also offer the possibility to cast and press these materials into ready made forms. In the automotive industry for example these processes can be used to gain light-weight and stable construction pieces. Despite non-woven materials offering a huge potential for forming and shaping furniture, this technology was not used in my work. Due to the even and condensed surface of compressed non-woven, a translucent character is hard to achieve without losing stability. For example, in order to obtain a translucent surface, openings or cut-outs would have been necessary and this would have diminished the stability. Furthermore the similarity to cast plastics led to the assumption that a more attractive and tactile surface could be created through a knitting or weaving technology.

*picture 28 - Non-woven with cut-outs
(huopaa)*

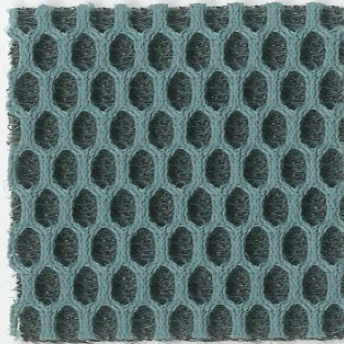


Knitting

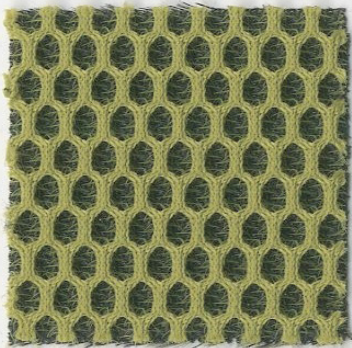
In contrast to non-woven, knitting offers translucency and elasticity. The knitting technology inter-meshes yarns through loops with each other and builds a stretchable textile. Compared to weaving, the knitted yarn has more space to move and is not as tightly bound as in woven fabrics. (Spencer, 1983) For this reason knitting technology is preferred in the production of cloth and in fact the most self-supporting contract textiles are constructed via the knitting technology, as the examples from the companies Gabriel and Pugi show. Through its open and transparent or semi-transparent character, the knitted surface offers an interesting material providing comfort and openness at the same time. These materials are often produced by warp knitting technologies which offer higher stability and durability than the weft knitting. Also very popular are so called spacer knits which are three dimensional fabrics which contain a ground and a top layer connected through pile yarns. These fabrics are known for a good airflow, elasticity, and softness. Their applications vary from apparel garments over seat covers to medical and filtration textiles. (Bruer, Powell and Smith, 2005) In chair upholstery in particular they are used to provide comfort without additional softening foams or cushioning.



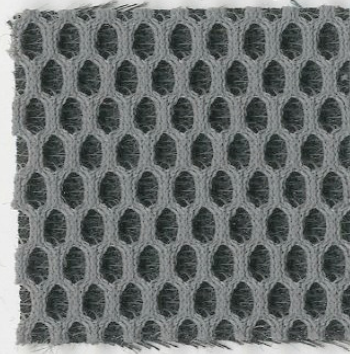
picture 29 - Warp knitted upholstery (Pugi)



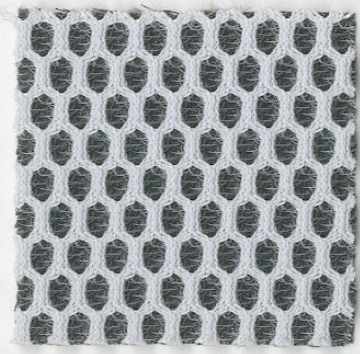
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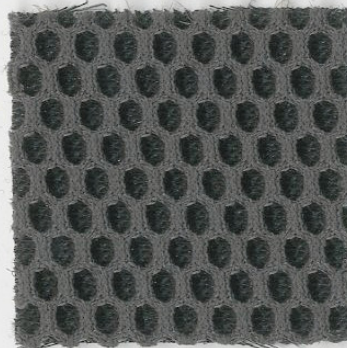
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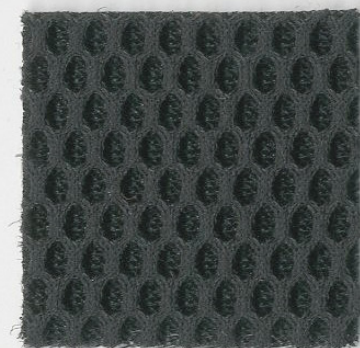
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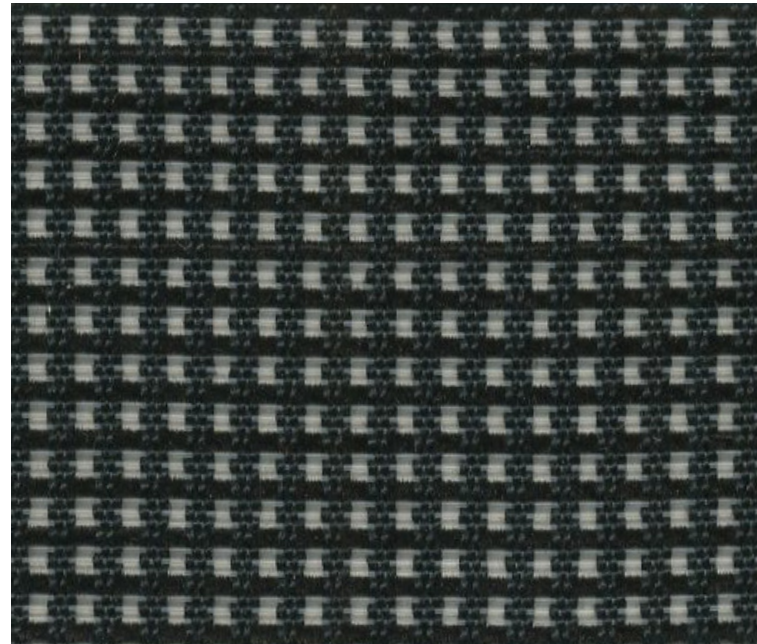
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picture 30 -
Spacer knit upholstery (Gabriel)

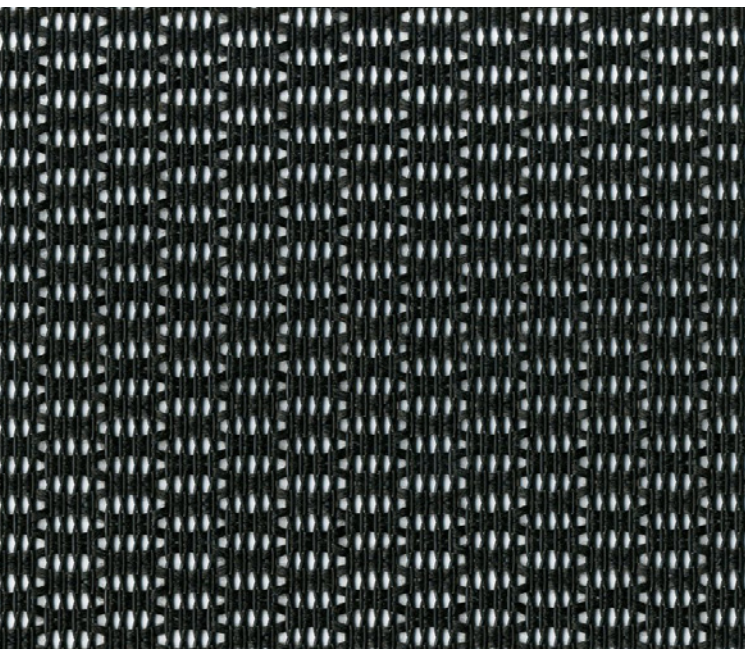
Weaving

Despite the fact that knitting technology seems to be the preferred choice for the production of self-supporting contract textiles, the weaving technology is the most frequently used technique in upholstery fabrics. Through the binding structures the weaving process offers various opportunities for design and colouring. At the same time very strong and durable fabrics can be produced. Woven fabrics are mostly used in furniture applications since their surface offers a very high resistance against abrasion. Due to the fact that there is a large diversity among woven fabrics, it is important to notice that the textile always has to fit to the particular purpose it has been developed for. Woven upholstery fabrics are usually be developed for a long life purpose. It is more common to replace the entire piece of furniture rather than changing the upholstery. For the weaving this means for example working with binding structures without long floating yarns. Free laying yarns in a textile tend to move extensively and in the case of an upholstery the pressure and movement of a person sitting on the fabric results in high strain for the fibres. Therefore the woven structure has to be as tight as possible to avoid free

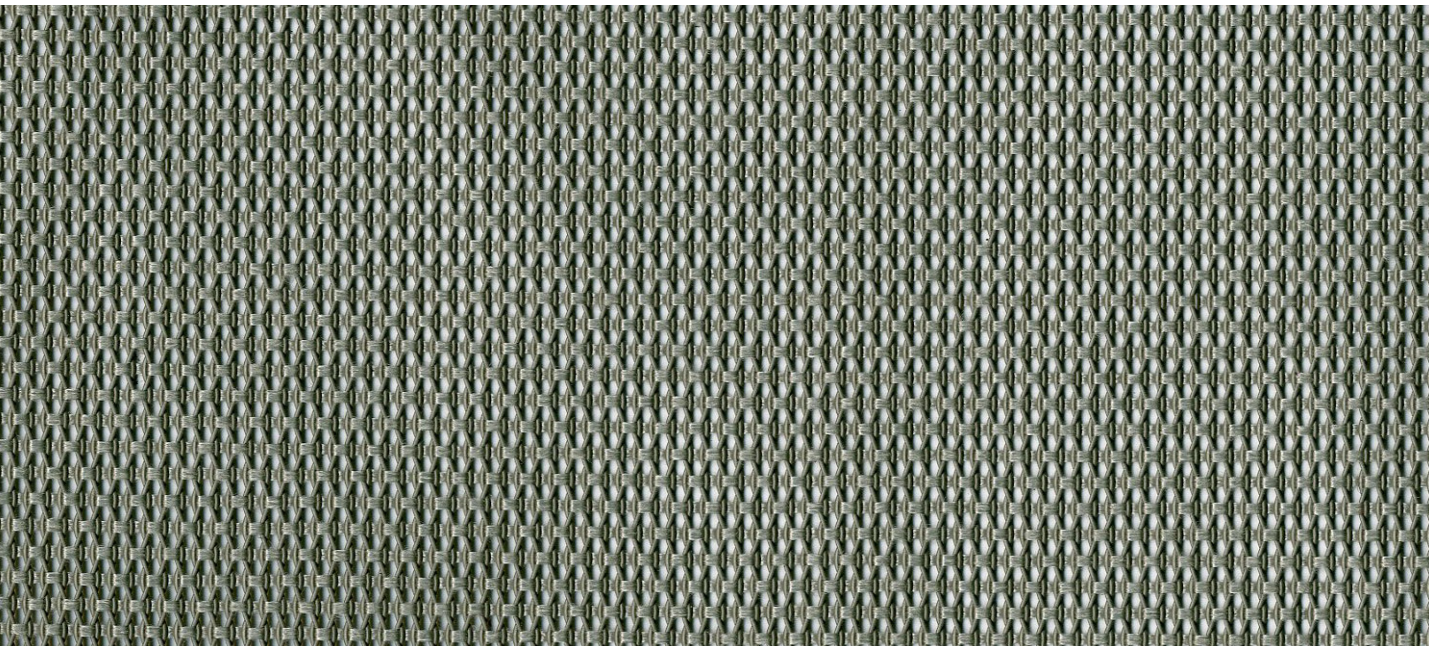
moving floats. A woven fabric is less elastic in its construction than a knitted one, but this also depends on the parameters of yarn and structure. In this sense weaving offers a high potential to cross section yarns in a manner that all threads can be bound in a condense way. In contradiction to that it is a great challenge to create a translucent woven upholstery which still would be durable.



*picture 31 - Self-supporting upholstery fabric
with tight plain weave (K+R Textil)*



picture 32 & 33 -
Self-supporting upholstery fabrics with leno weave (Pugi RG)



3.2 Correlation of Material and Structure

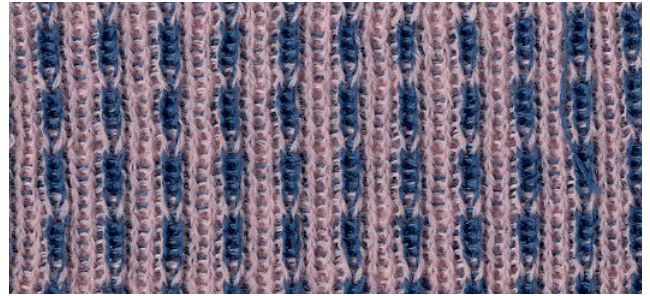
Following the explanation of these two parameters, material and structure, separate from each other, it is important to notice the complex interplay between them. Both factors play an important role in the performance of the fabric and they are interdependent. Depending on the material, the structures of a fabric can usually be formed differently. Sometimes it is even impossible to build a certain structure with a specific material. Factors like density, stiffness, elasticity and many others influence the behaviour of both. In order to illustrate this complex correlation, an experiment from my research provides a good example. In the experiment, a special synthetic yarn was tested in combination with a polyester yarn. Both materials are primarily more suitable for weaving, because of their strong and stiff character. Nevertheless, during the design process it is necessary to also test materials which appear not suitable. For these try-out samples, different knitting structures were tested. These included a pleat structure, a jacquard and a technique with transferred stitches. The results showed that structures where both materials had been used separately, it was possible to knit the test samples without any problems. For example the pleat structure works very well when the special yarn runs only in the back layer and the polyester in the front layer. In contrast the jacquard and the structure with transferred stitches caused many problems, due to the frequent

intercrossing of the two materials. This led to looping up of the yarns and resulted in holes in the sample. To compare, a sample with soft and elastic wool was knitted. In this instance the structure proved no problems. In conclusion of this test it can be said, that most probably the relatively stiff yarns in combination with the difference of the two materials were the key factors causing these problems.

As this example shows, it is important to be aware of the complex interplay between material and structure. Often it requires a deep technical understanding to locate the source of problems and a guidance by textile technicians can be beneficial in many ways. During the process of finding the right materials and structures it was very helpful to get support from studio masters and professors at the Aalto University Department of Design as well as from several experts within the industrial field.



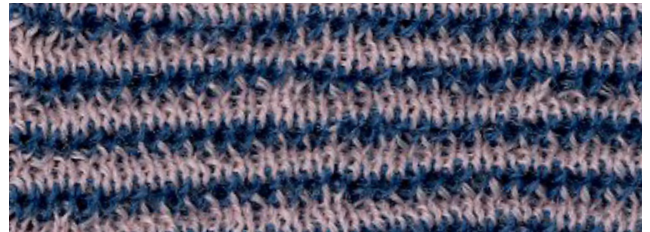
picture 34 - Jacquard technique with special yarn and polyester



picture 35 - Jacquard technique with soft wool



picture 36 - Transferred stitches with special yarn and polyester



picture 37 - Transferred stitches with soft wool

picture 38 - Pleat structure with special yarn and polyester, front



picture 39 - Pleat structure with special yarn and polyester, back



3.3 Process Phases

In the following paragraphs I will explain my design process in more detail. While the requirements of the fabric concept offered great challenges, my method to find suitable solutions was through series of trials. In review, my design process can be explained in three phases. Beginning with various ideas, it continues to selections of promising materials and structures, and ends with final suggestions and findings.

Phase 1 – Various Ideas

At the first meeting with Bogdan Chernyakevich he described the main ideas of his design concept, which included the challenge to combine translucency and supporting strength in one fabric. Furthermore, the requirements for a piece of upholstery suitable for use in public spaces increased the challenge of my task. In order to cope with those requirements, I tried to focus on separate parts of the problem. One aspect I concentrated on was on the search of structures and materials which create translucency. Apart from this I focused on the self-supporting properties of textiles. In addition, my search also took into account the quality requirements of contract textiles.

In order to find a starting point with my test samples, I focused on the aspect of high strength and translucence. Materials such as metal wires and nylon were the first intuitive suggestions. Additionally, the assumption that the knitting technology will offer the best potential according to elasticity and flexibility, lead to the first knitted samples.

The first experiments with hand knitting machines revealed that the first assumptions did not lead to the desired results.

Openwork and lace structures should fit with the idea of translucent textiles by creating net-like surfaces. While the property of knits is already elastic, the mesh designs amplified this effect. As a result the test pieces were very stretchable in their structures and would not offer a firm enough construction. Of course, this depended heavily on the chosen material. Metal wires produced a much stiffer fabric than the already more elastic nylon. For this reason a study of the material was also important.

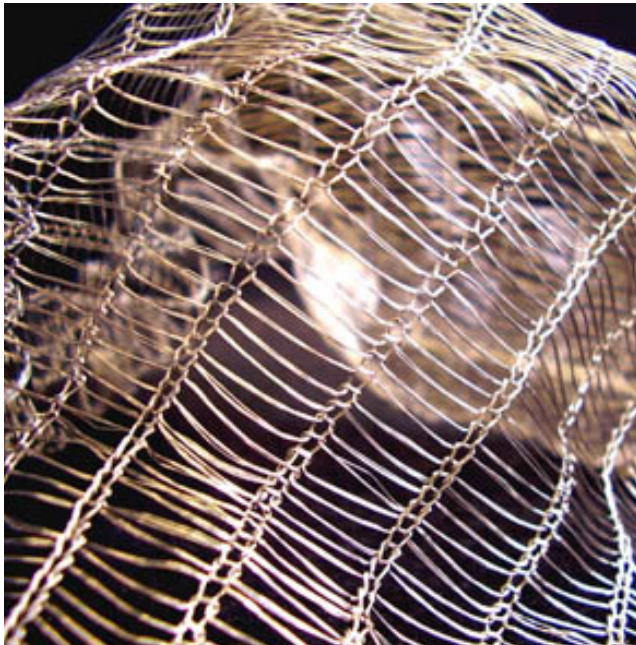
Metal

Regarding the metal wires, fabrics with a very stiff appearance could be achieved, but at the same time the garment could easily be deformed and could not reshape itself to its original form, due to the low resilience character of metal. Furthermore, the grip of the swatches was quite harsh and did not provide a sufficient result. Also, as metal itself is not a lightweight material, a final fabric version including metal wires would have led to a very heavy construction.

Nylon

In comparison, the use of transparent nylon revealed a more stretchable and flexible construction. However, in consideration of the requirements for contract textiles, further research showed that the selection for nylon yarns has to be done carefully. The proper chemical name of this synthetic yarn is polyamide, commonly known through its

use in materials like fishing line or nylon stockings. My first association of nylon was of a transparent, strong and durable material. Further research showed that this material belongs to the group of thermoplastic synthetics, which allow the material to deform at a certain temperature (Didaktik der Chemie, FU Berlin, 2000). Therefore polyamides tend to melt, but also burn when set on fire. Special fire retardant treatments can prohibit this, but there exist other modified synthetic fibres which offer better performance (Horrocks and Price, 2001). Furthermore, some polyamide fibres show a low pilling resistance which would not suit high abrasion demands (Corbman, 1983). In general, polyamide fibres are rarely used by manufacturers of contract upholstery fabrics. Nevertheless,



the elastic properties of polyamides are very good and they are stable against different chemicals which support cleaning processes. Despite that, the light fastness properties of most polyamides are not as long lasting as those of other synthetics. After long exposure to bright sunlight polyamides may lose their strength. (Moncrieff, 1975; Quinn, 1985) For these reasons polyamides have to be carefully chosen in order to make sure that they meet the required standards.

After further discussions and in accordance with the previous observations, the decision was made to concentrate the material research on the group of synthetic fibres with fire retardant properties. This provided a practical starting point for a more likely positive performance of the fabric at a later time, according to the fire quality standards.

The experience of this first testing phase and the discussion processes lead to a narrower selection of fire retardant synthetic fibres and the further development of knitted and woven structures.

picture 40 - Knitted metal (inntex)

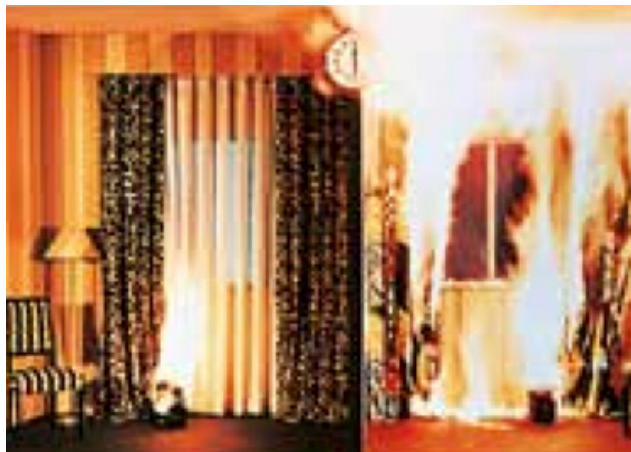
Phase 2 – The right Material

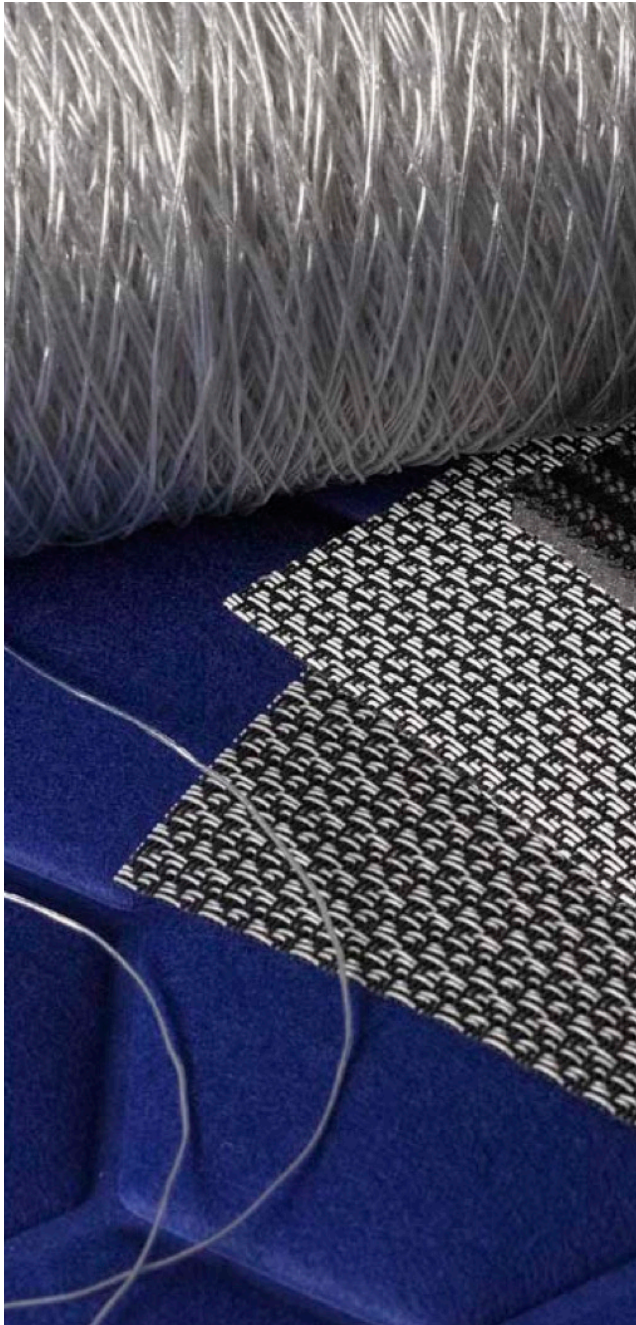
Trevira CS

Further research of upholstery textiles among contract textile manufacturers revealed the frequent use of polyester, especially of the popular brand Trevira CS. This modified polyester is produced by the company Trevira, which offers a wide range of different qualities of yarns and fabrics. Due to the demand for fire retardant textiles within the public sector and an increasing request in the private textile sector as well, the variety of Trevira CS yarns has been expanded. (Trevira GmbH, n.d.) Besides the Trevira CS label, other different brands exist such as Fidion FR or Diolen®Safe and no-name products for fire retardant yarns and fabrics (FR safety yarns, n.d.; Montefibre S.p.A., n.d.). However, for a product marked with the trademark Trevira CS, the company states that these products “are noteworthy for high colour brilliance and fastness to light. They are extraordinarily hard-wearing and retain their attractive qualities for a long time, even with intensive use. Upholstery fabrics withstand high levels of abrasion and do not stain other textiles.” (Trevira GmbH, n.d., p.3) Due to these positive qualities I chose to use Trevira CS yarns for further samples.



*picture 41 & 42 - Trevira CS fire retardant polyester fabrics;
Compared to other textiles they burn
slower and do not spread the fire(Trevira)*





CoreCoat PUR

In addition to the polyester fibres, fire retardant polyurethane yarns offered interesting possibilities for my work. This synthetic fibre is often used within the contract sector, especially in the automotive industry or as an upholstery foam for furniture. The special character of high abrasion resistance is combined with a smooth appearance when it is used as a coating. (Hibbert, 2004) Secondly, special modifications for fire retardant polyurethane fibres can be produced. One example is the CoreCoat yarn from the company Recytex. These yarns combine a polyester or glass fibre core yarn with a polyurethane coating. Depending on the potential end-use of the material, parameters such as light fastness, abrasion resistance, tensile strength and flammability can be modified. (Recytex GmbH & Co. KG, n.d.)

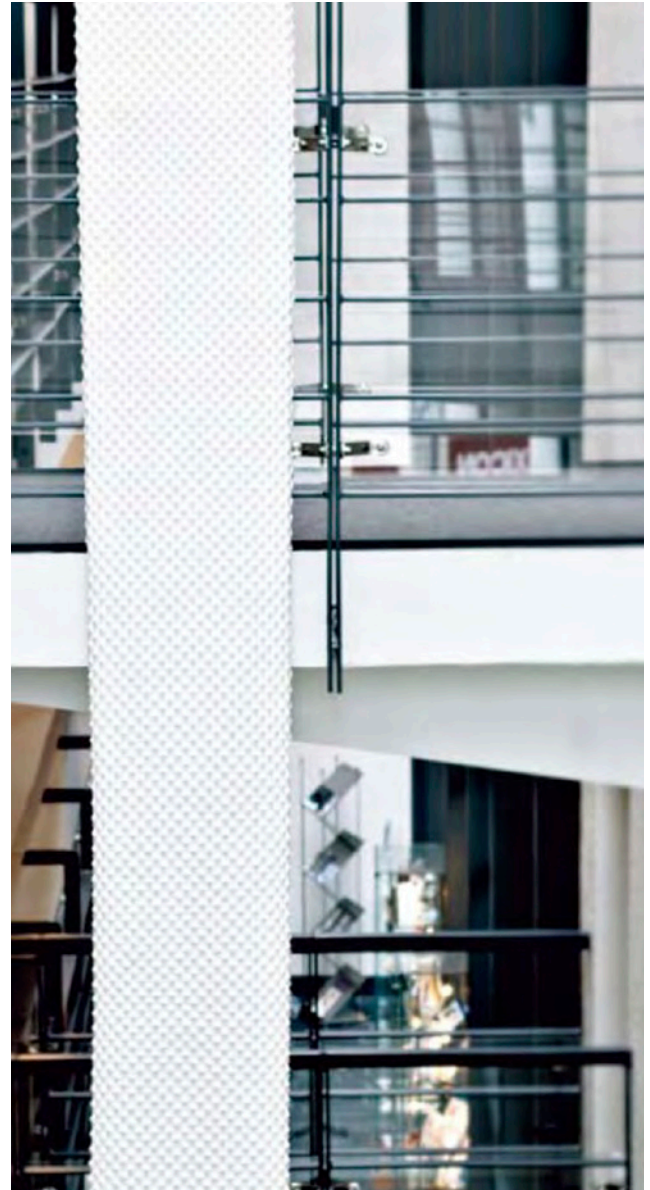
Due to these versatile properties the CoreCoat yarns offered a great opportunity for my development of a strong but light appearing textile. The company Recytex provided different types of flame retardant polyurethane yarns that I was able to test in the further experiments.

*picture 43 - CoreCoat polyurethane
yarns (Recytex)*

Pemotex

In addition, the search for a fire retardant, meltable yarn seemed to be promising. A specially modified polyester fibre called Pemotex can melt and stiffen when the yarn is heated. A project of the Swedish School of Textiles, Borås used this property for creating textile acoustic panels for public spaces. (Eson Bodin, 2008) Inspired by this project, I wanted to test the usability of Pemotex for my fabric design.

The yarn itself is quite rough and has a paper like feeling. After the heating process the surface of the material becomes more even and rubber like. Since the material is smooth enough to be knitted, I wanted to test knitted openwork structures and pleated surfaces. My assumption was that the melting character could be advantageous in gaining a stiff upholstery. Therefore, I developed different test pieces with hand and industrial knitting machines. Depending on the structure and the combination with other materials, the Pemotex could more or less be knitted well. The best possibilities could be achieved through a combination of Trevira CS with Pemotex in a striped pleat design, which also offered a nice optical effect. At the same time the heating and pressing process transformed the three dimensional surface of the fabric into a completely new surface. In contrast to this, a disadvantage of the pleated structure and the melting process was that the fabric was not translucent. Furthermore the samples showed that the melted and stiffened surface could easily be destroyed by harsh pulling. Finally, this experiment showed that even though the material is very fascinating, it does not provide the necessary strength for a self-supporting upholstery. Therefore the Pemotex yarn was not taken into further consideration.



*picture 44 -
Acoustic panel with Pemotex yarn
by the Swedish School of Textiles
(Nordic Textile Journal)*

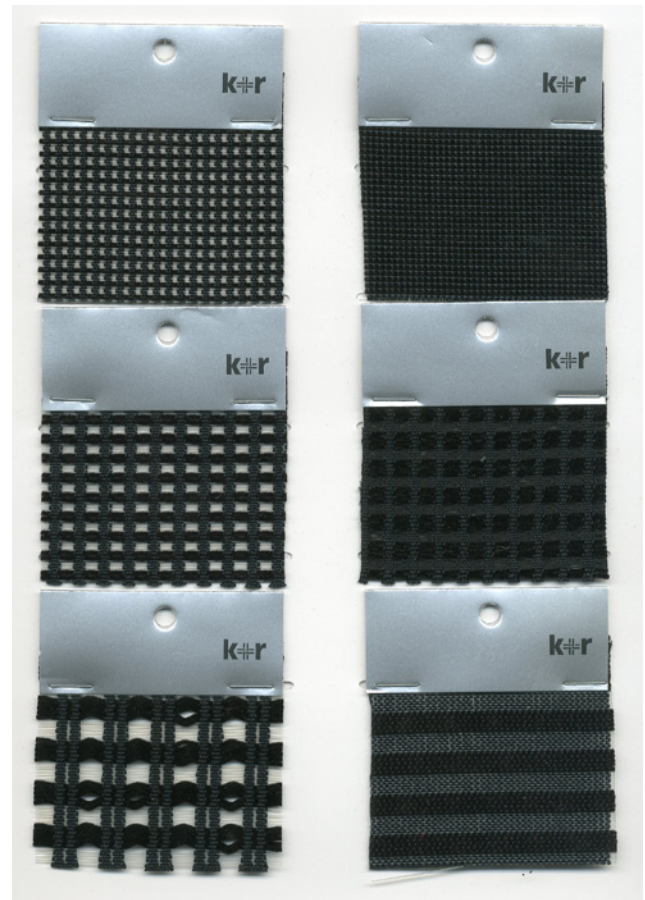


picture 45 -
Knitted sample with Pemotex yarn before (left)
and after (right) the heating process

SHRINX System

Another interesting finding related to meltable fibres surfaced during my research of existing self-supporting upholstery. A method to adjust a fabric exactly to the shape of a piece of furniture through a shrinking process was fascinating. The manufacturer K+R Textil produces this special upholstery and through their patented SHRINX technology system it is possible to shrink fabrics to the specific form of a furniture frame. For example, a seat cover for a chair is sewn in an overlarge size and is applied to the frame of the chair. Later on, the whole chair will undergo a heating process during which the textile will contract and is fitted to the actual size of the furniture. Through this process it is possible to attach self-supporting upholstery more evenly and with equal tension, to different kind of furniture shapes. Furthermore, these woven fabrics display an attractive alternative to the widespread warp-knitted self-supporting upholstery and use the versatility of woven structures. (K+R Textil GmbH & Co. KG, n.d.) Information about the materials, provided by the company showed that the fabrics meet the high abrasion and colour demands for the use within public spaces. A disadvantage is the fact that the fabrics fulfil only the first part of the fire safety standard EN 1021. Therefore the usage of these textiles has to be considered in accordance with the distinct location. On the other hand, the use of transparent polyamide yarns gives the upholstery a translucent and even transparent character. The combination of shrinkable, translucent, and self-supporting properties offers a great possibility for the furniture concept of Bogdan Chernyakevich. Therefore a cooperation with the company K+R Textil might be beneficial for the realization of this furniture project.

Nevertheless, further progress of my materials test showed that the combination of Trevira CS polyester and the fire retardant polyurethane CoreCoat yarns also offers creative and interesting design solutions. A collection of woven fabric samples shows the potential of this technology and its structures.

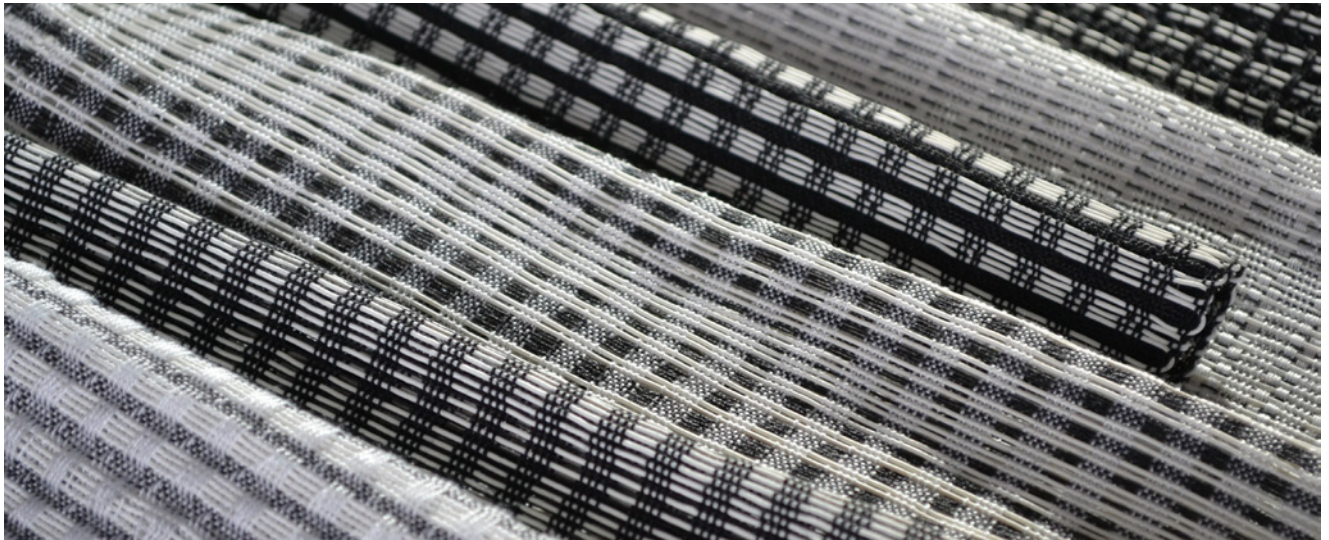


*picture 46 - Shrinkable upholstery fabrics
(K+R Textil)*

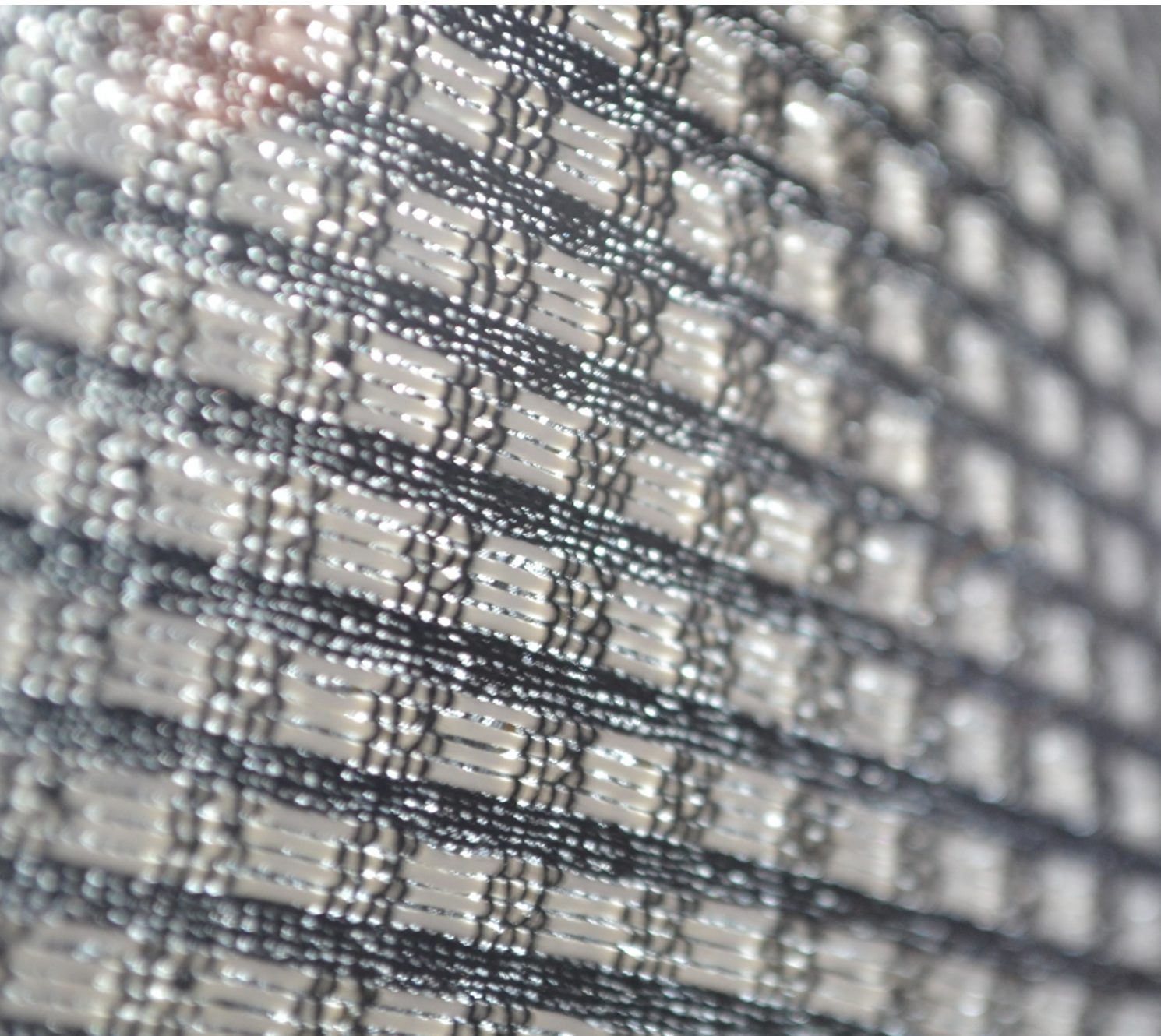
Phase 3: Final Collection

During the process of making the final sample collection on a hand weaving loom, the CoreCoat yarns revealed their stiff character. In combination with the Trevira CS polyester yarns it was possible to create openness through several binding structures. While the polyurethane material kept the fabric stiff, the thinner and more flexible polyester yarns allowed to tie threads together. In this way I was able to create firm and solid bindings within the fabric. Furthermore, it was possible to develop open structures, especially through the usage of so called mock leno weaves. These structures group and bind several threads tight together and produce in this way open spaces. The stiff polyurethane also supported these open structures. Due to its low flexibility and elasticity the CoreCoat yarns prohibited a too dense surface. Moreover, structures with plain weave which left out warp yarns led to open parts within the textile.

The whole collection should be seen rather as ideas and suggestions of what can be achieved, than as ready to use textiles. Due to the fact that they are developed on a hand loom, the fabrics might not pass rigorous quality tests. Furthermore, it is hard to give valuable predictions about a possible in-use performance of the fabrics. The densities could have been woven in a tighter and more solid manner with an industrial machine. Also, some samples are more adventurous and play with longer floats than others, so a realization would require the adjustment to a mechanical production process to assure that the fabrics meet the required quality standards. However, through the combination of the polyester and polyurethane material together with open binding structures, it was possible to create translucent, but also solid textiles. These material samples are included in a collection of woven structures and can be found attached to this thesis.



picture 47 - Final collection





Translucence

Openings in the binding structures let the light pass through. For this reason the textiles appear different, depending if the view is against or with the light. This playful effect also underlines the concept of optical illusions. The fabrics of my collection invite to study the surface and to explore their playful character. Furthermore, the white and black materials absorb or reflect the light in a different way. The perception of the textile, therefore, always depends on the light.

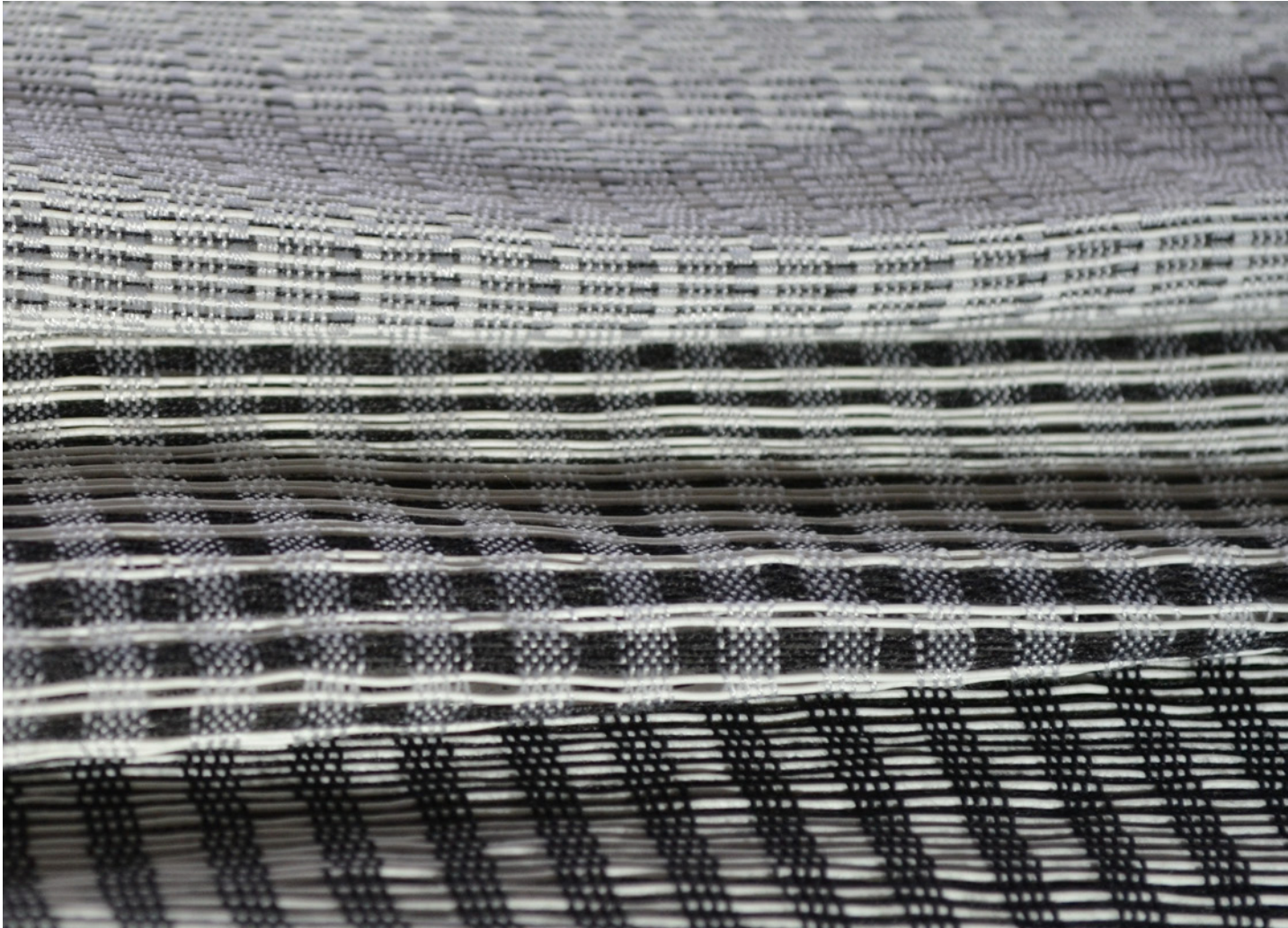
picture 48 - Translucent fabric, design Brick

Plain Weave Structures

The samples Track, Wave, and Slot contain the same or related binding structures. Based on a plain weave structure, the fabrics Wave and Slot have a more translucent effect. Through the technique of left out warp yarns, I could play with open

spaces and stripe designs. At the same time these fabrics contain long floating yarns which creates a more fragile structure.

picture 49 -
Designs Track (top), Wave (mid), Slot (down)



Track

The sample Track offers a more dense and solid construction. In this case I combined a plain weave with a ribs structure.

picture 50 - Design Track

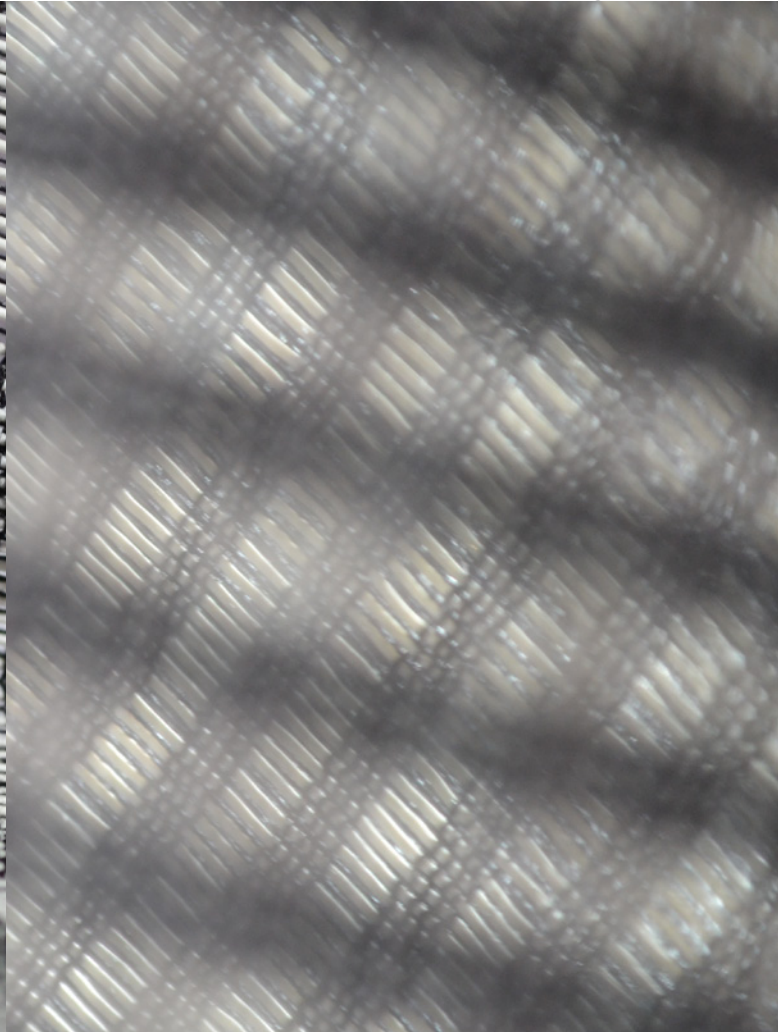
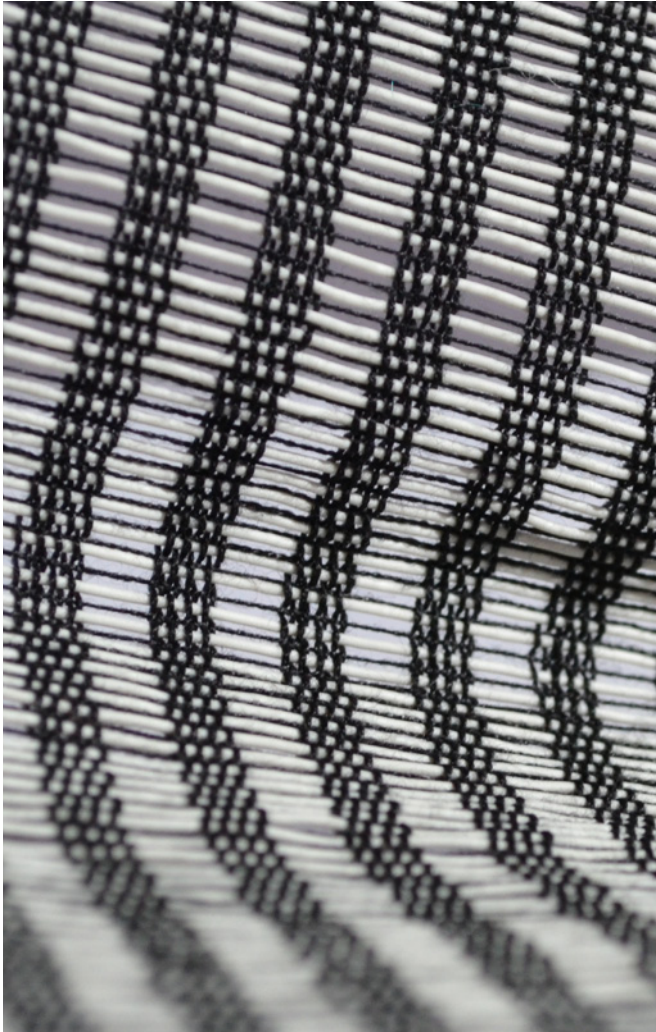


Slot

The sample Slot works in the same way as the fabric Wave with open structures by leaving out warp yarns. At first glance this design appears to be a plain surface with vertical stripes.

If it is viewed against the light, however, a gentle grid pattern becomes visible. This is caused by the combination of thick and thin yarns.

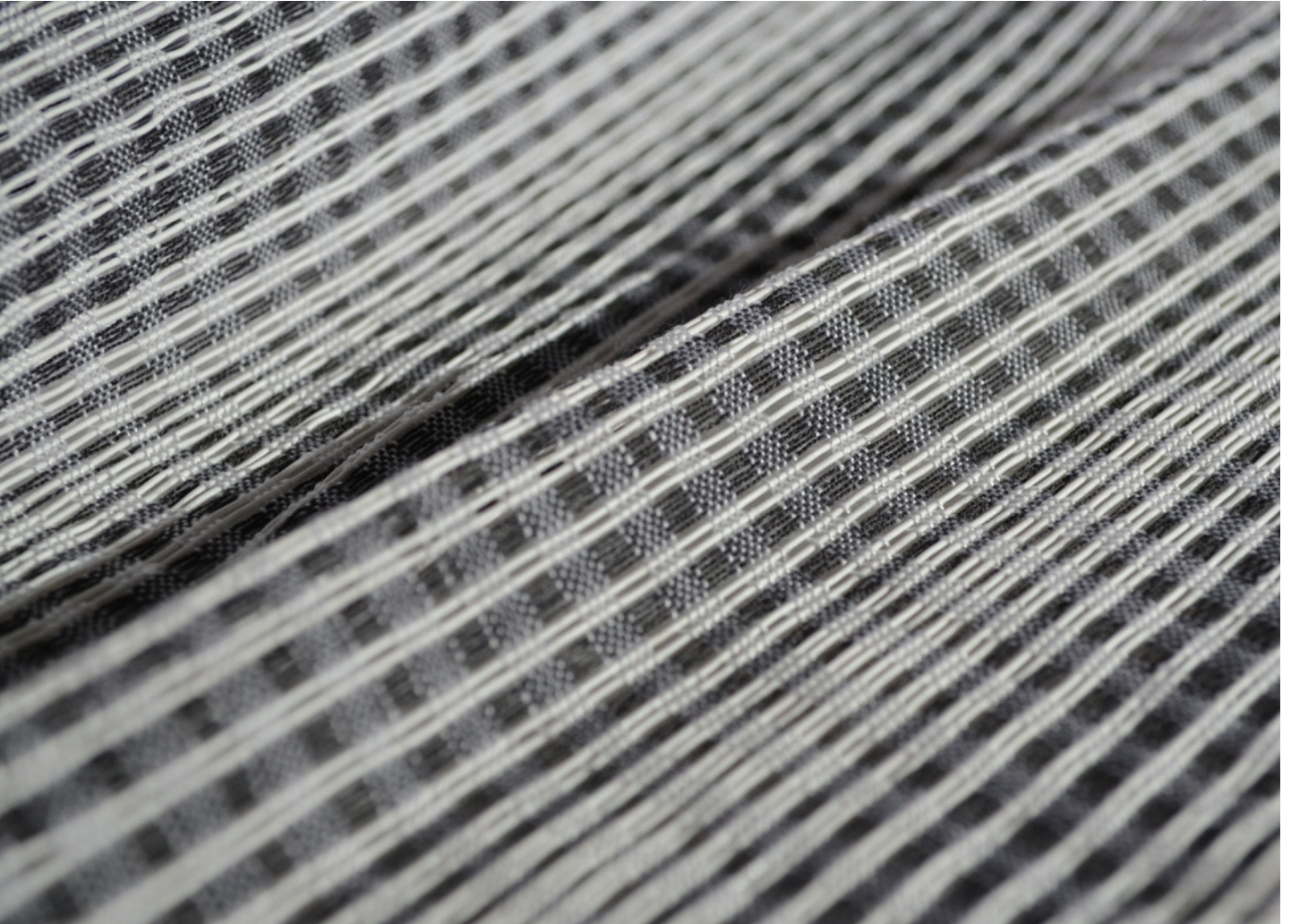
picture 51 & 52 - Design Slot



Wave

My focus in the fabric Wave was on the visual idea of the textile. The pattern includes a linear gradient of light and dark. In that way the design supports a moving and floating impression.

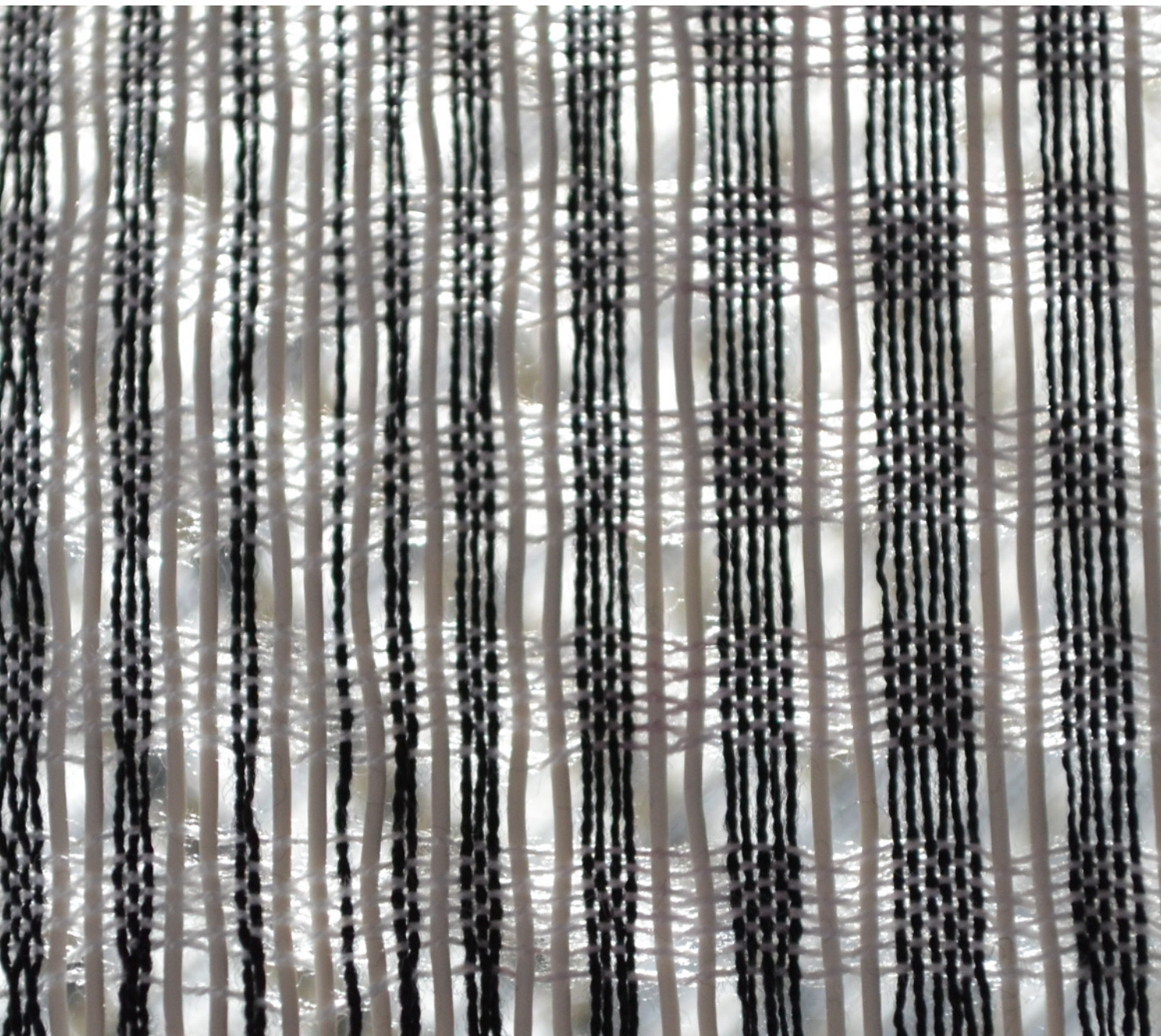
picture 53 - Design Wave

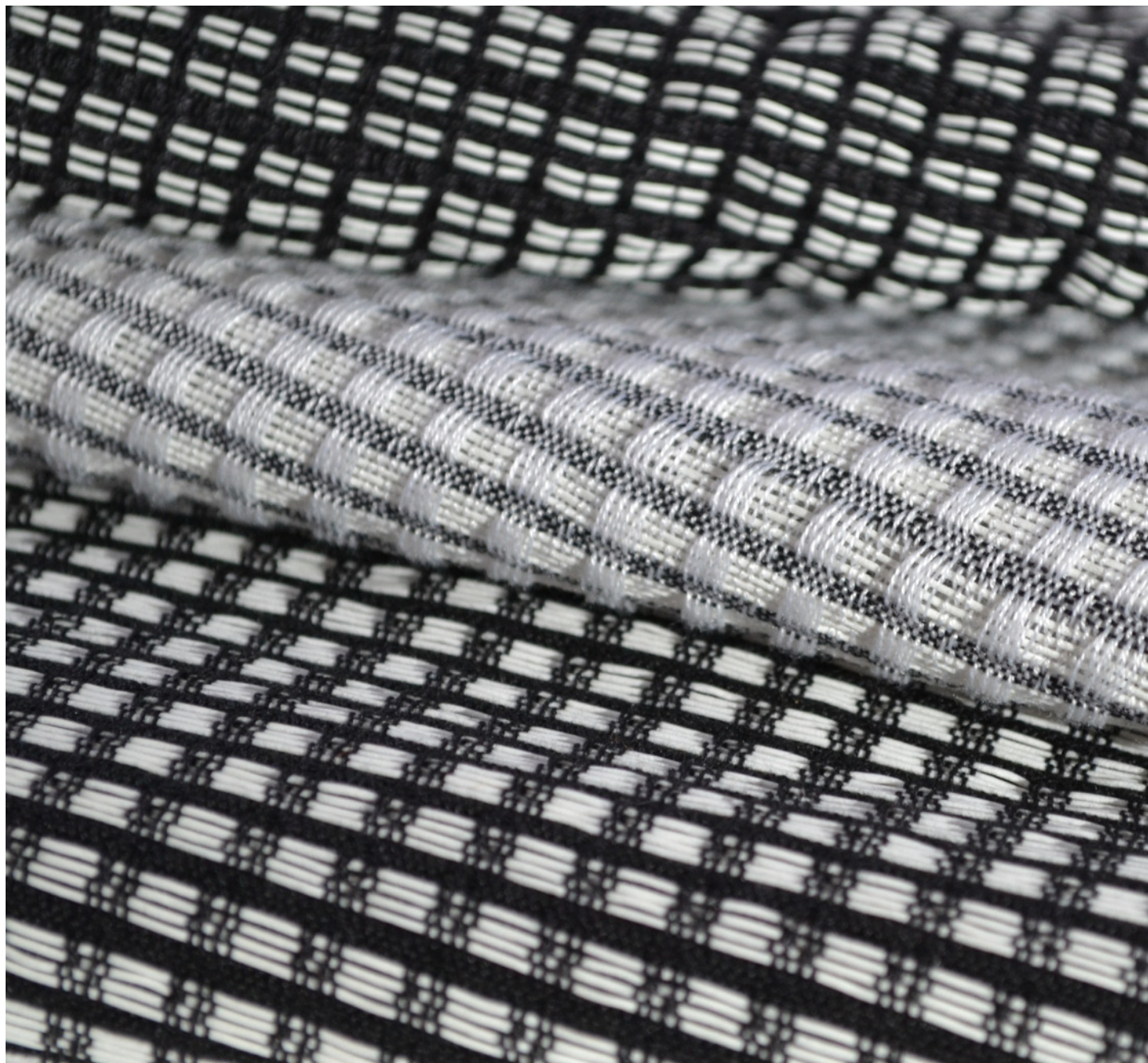


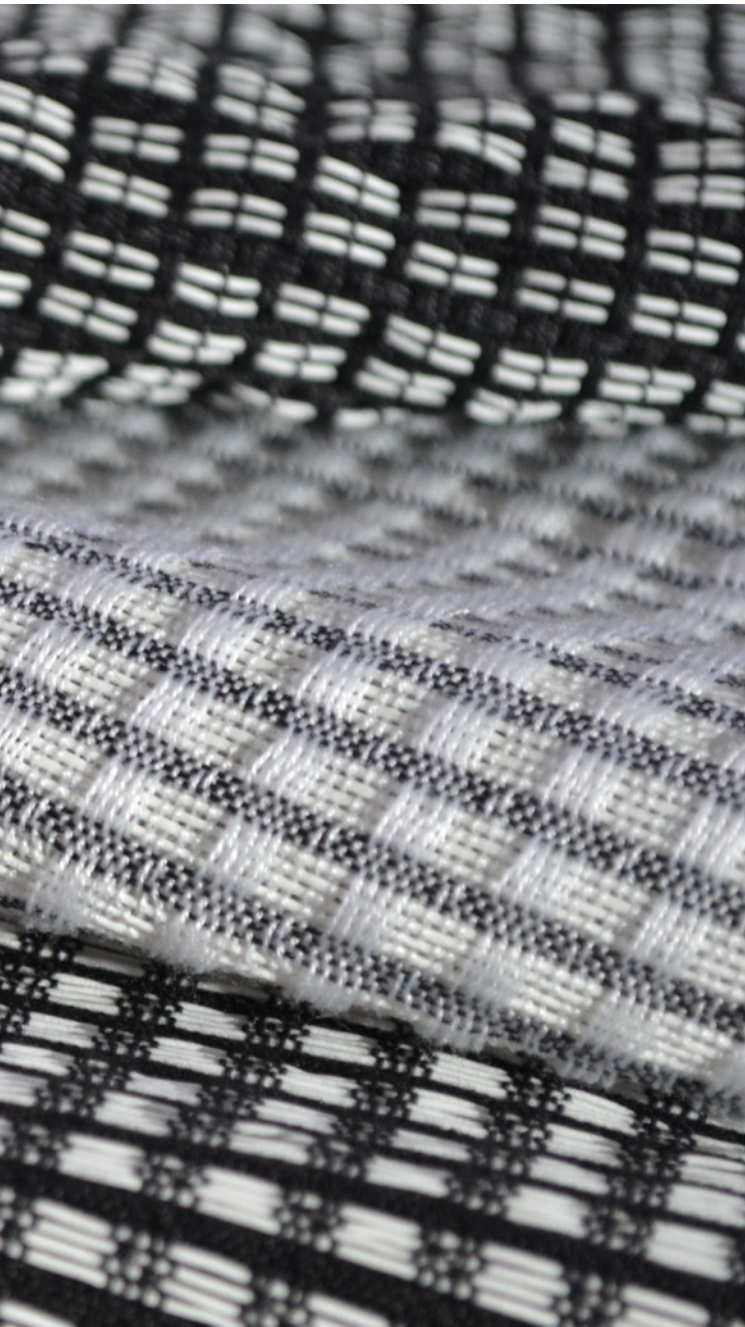
If the fabric is seen against the light, the obvious pattern vanishes and openings within the structure become visible.



picture 54 - Design Wave







Mock Leno Weave Structures

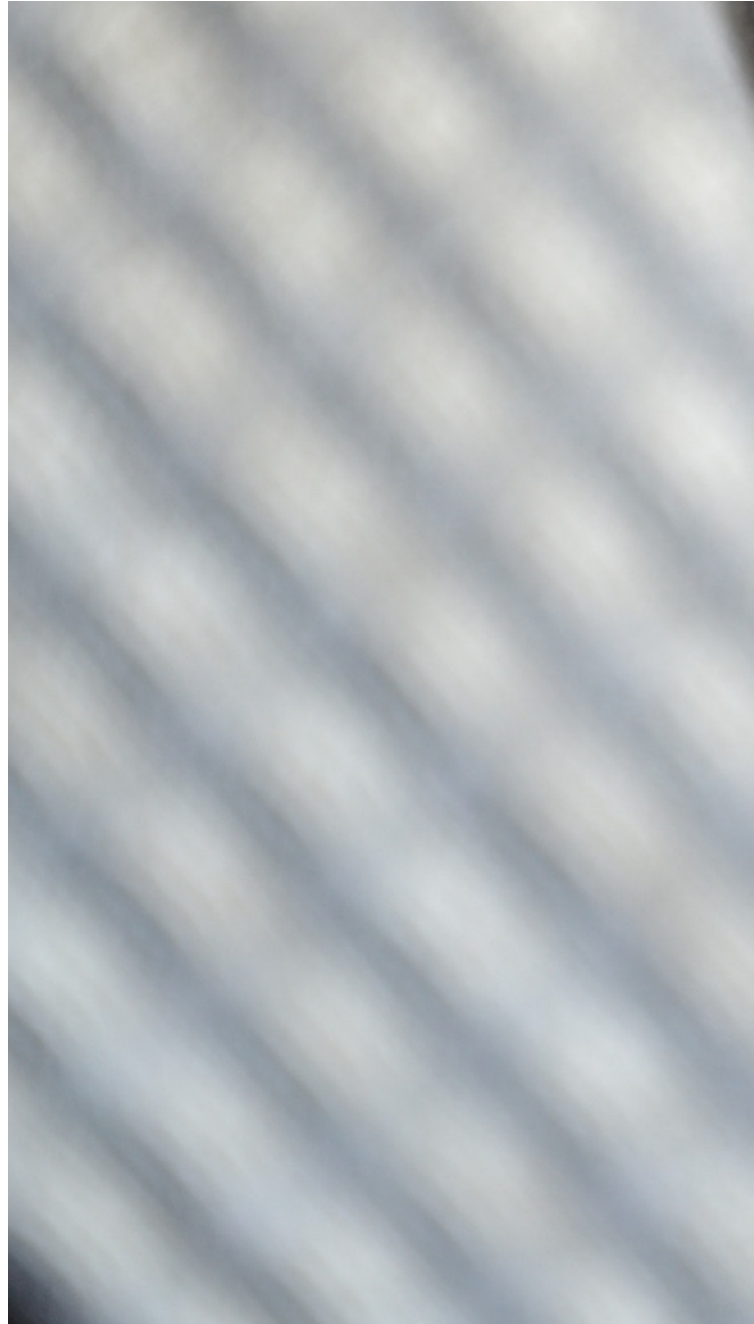
Further samples of my collection are based on mock leno weaves. The fabrics Grain, Gap, Notch, Brick, and Grid are constructed by these binding structures. Additionally through the use of floating yarns I tried to create open spaces by leaving out warp yarns. In comparison to the other fabrics which use plain weaves, these structures provide more solid constructions.

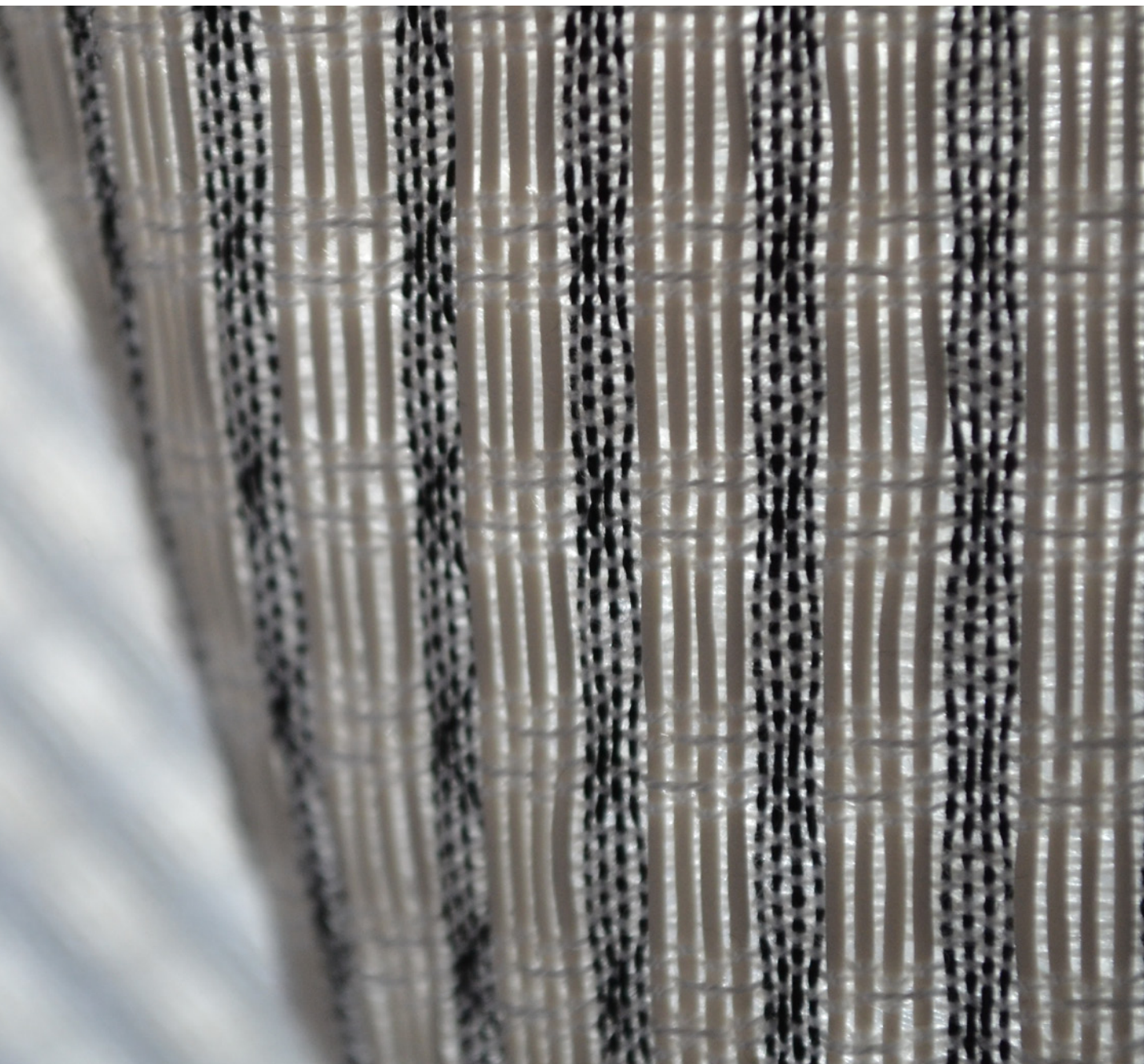
*picture 55 -
Designs Grain (top), Notch (mid) and Brick (down)*

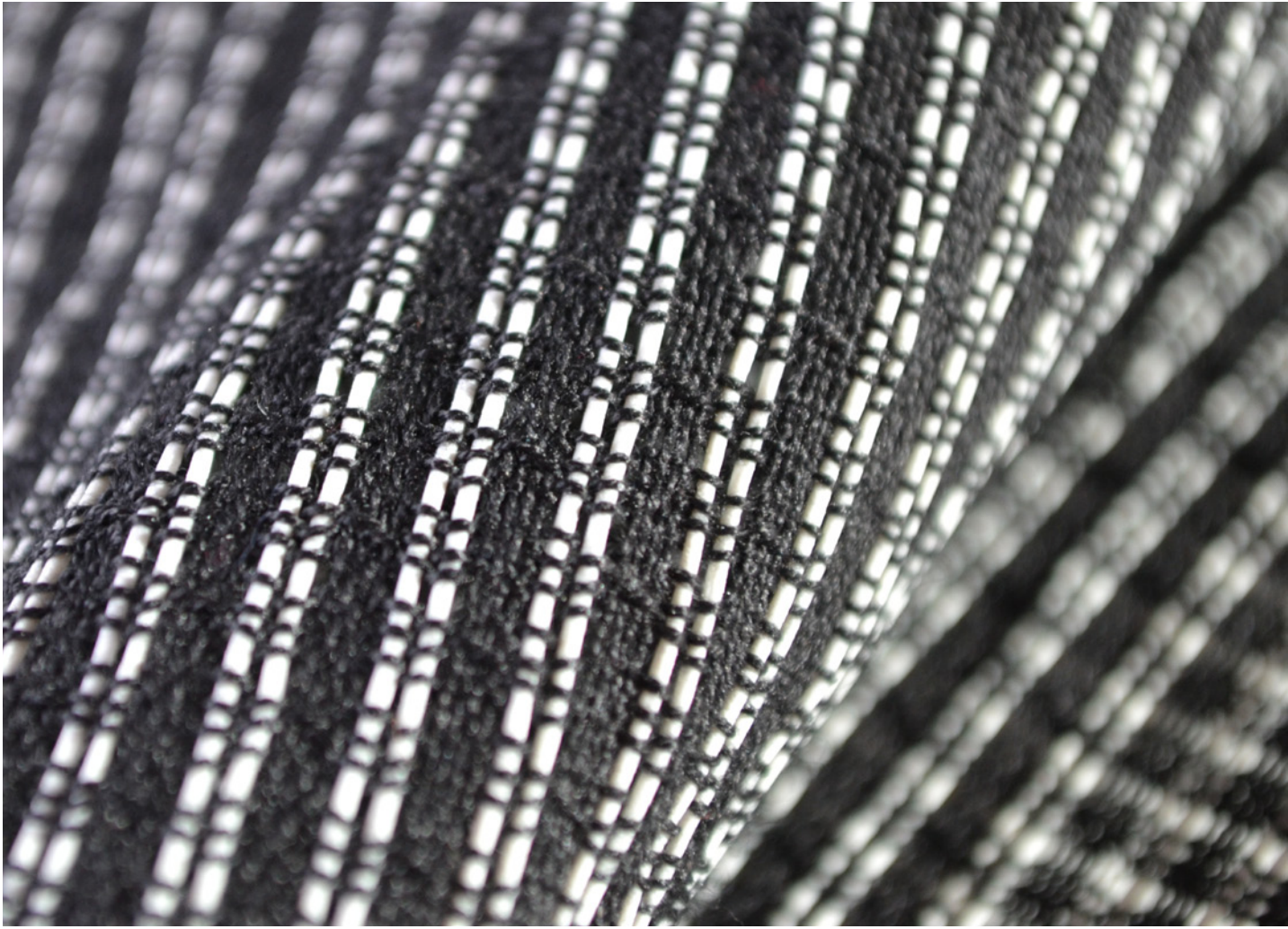
Brick and Notch

Even though the designs of Brick and Notch appear quite dense, they still allow the light to pass through. Both fabrics are identical except the warp colours. For the Brick design I used a black warp yarn, whereas the Notch design is woven on a white warp. This little change creates two different textiles. The darker sample displays a visible grid pattern, whereas the lighter design displays horizontal stripes.

picture 56 - Design Notch







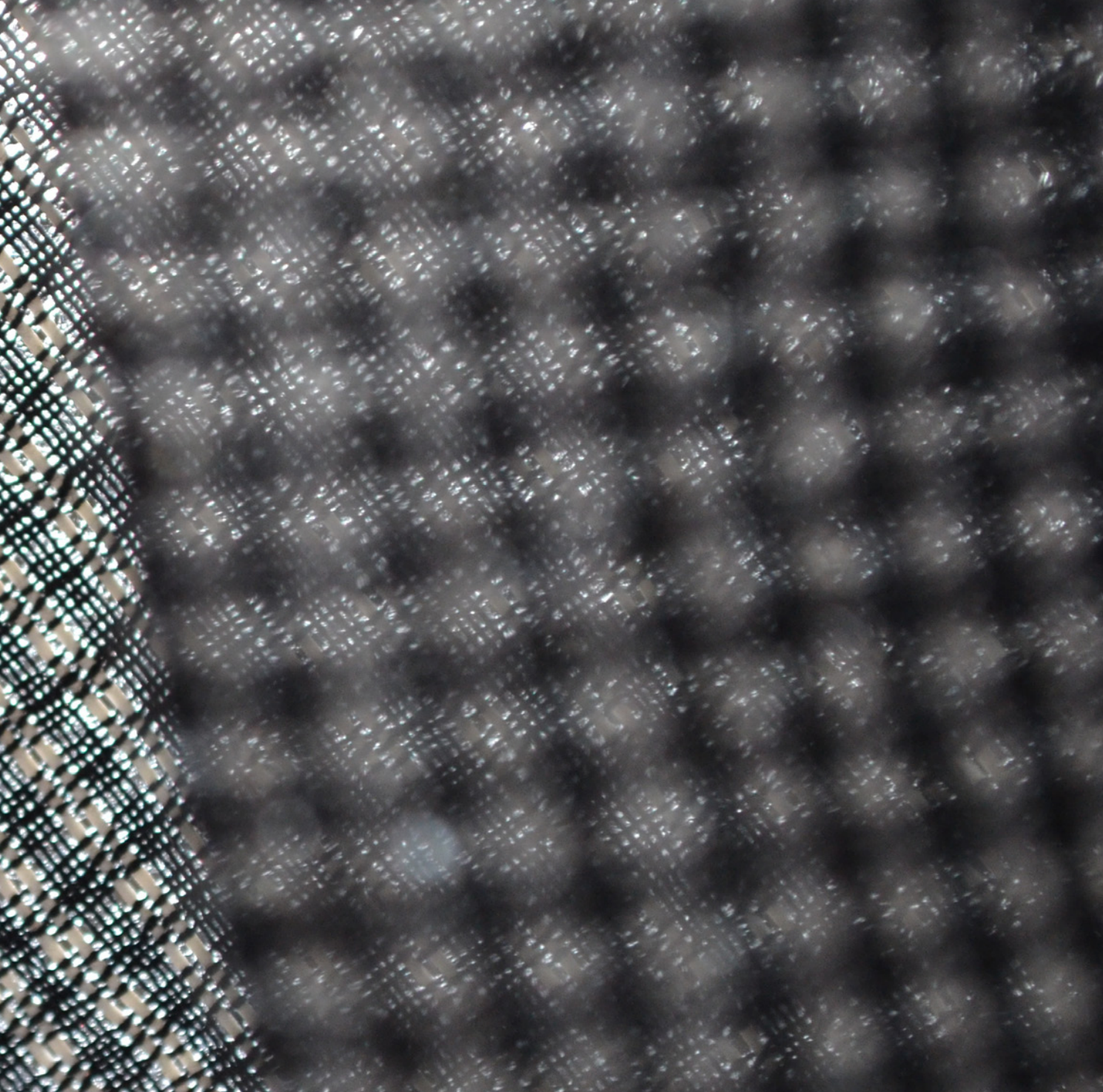
Grid

For the design Grid I used a mock leno weave and left out some of the warp yarns. The strong contrast of light and dark creates a visible pattern of horizontal strips. If the fabric is viewed against the light a small grid pattern becomes visible.



*pictures 57 & 58 - Design Grid
following page: picture 59 - Design Grid*





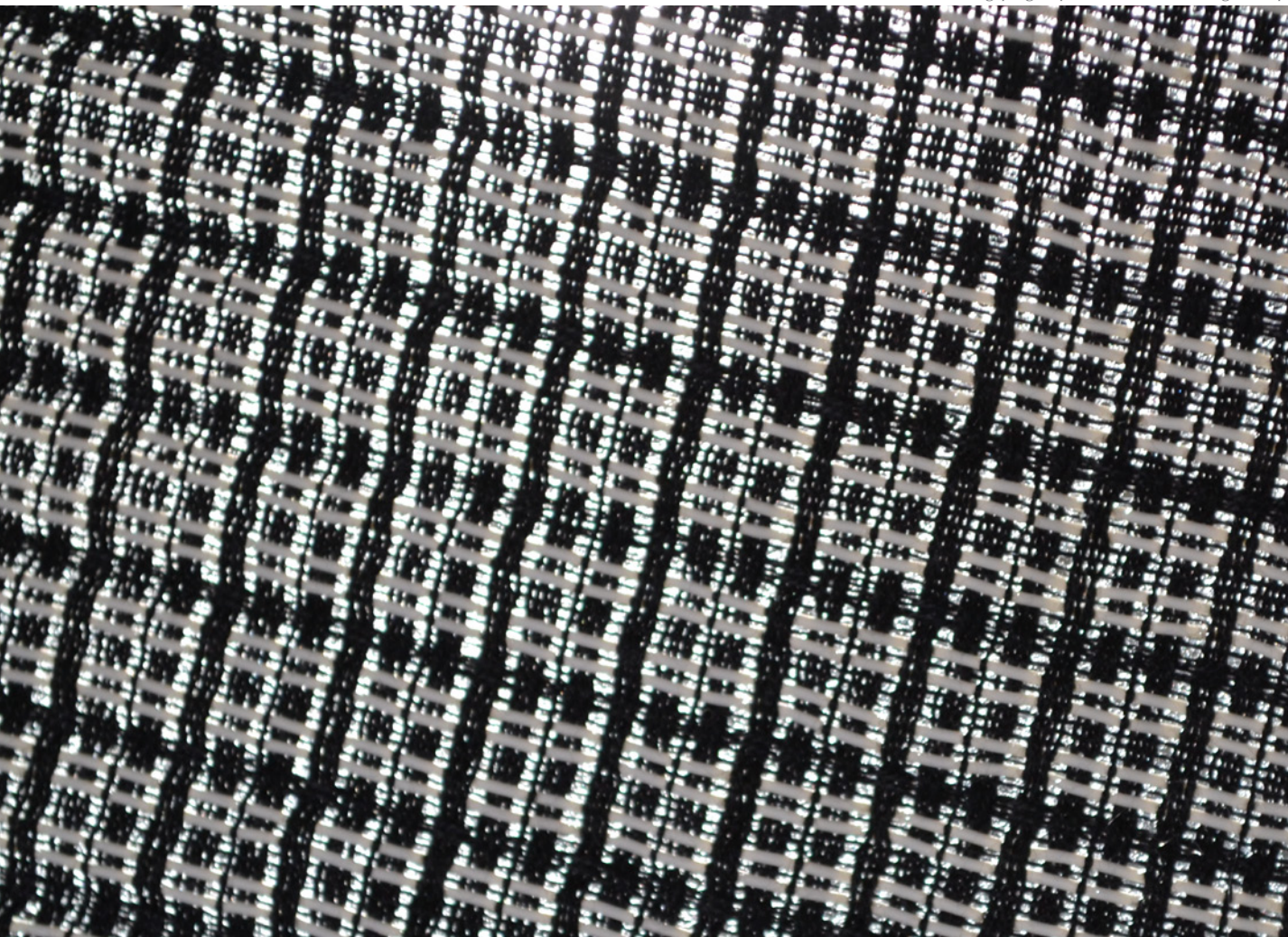
Grain and Gap

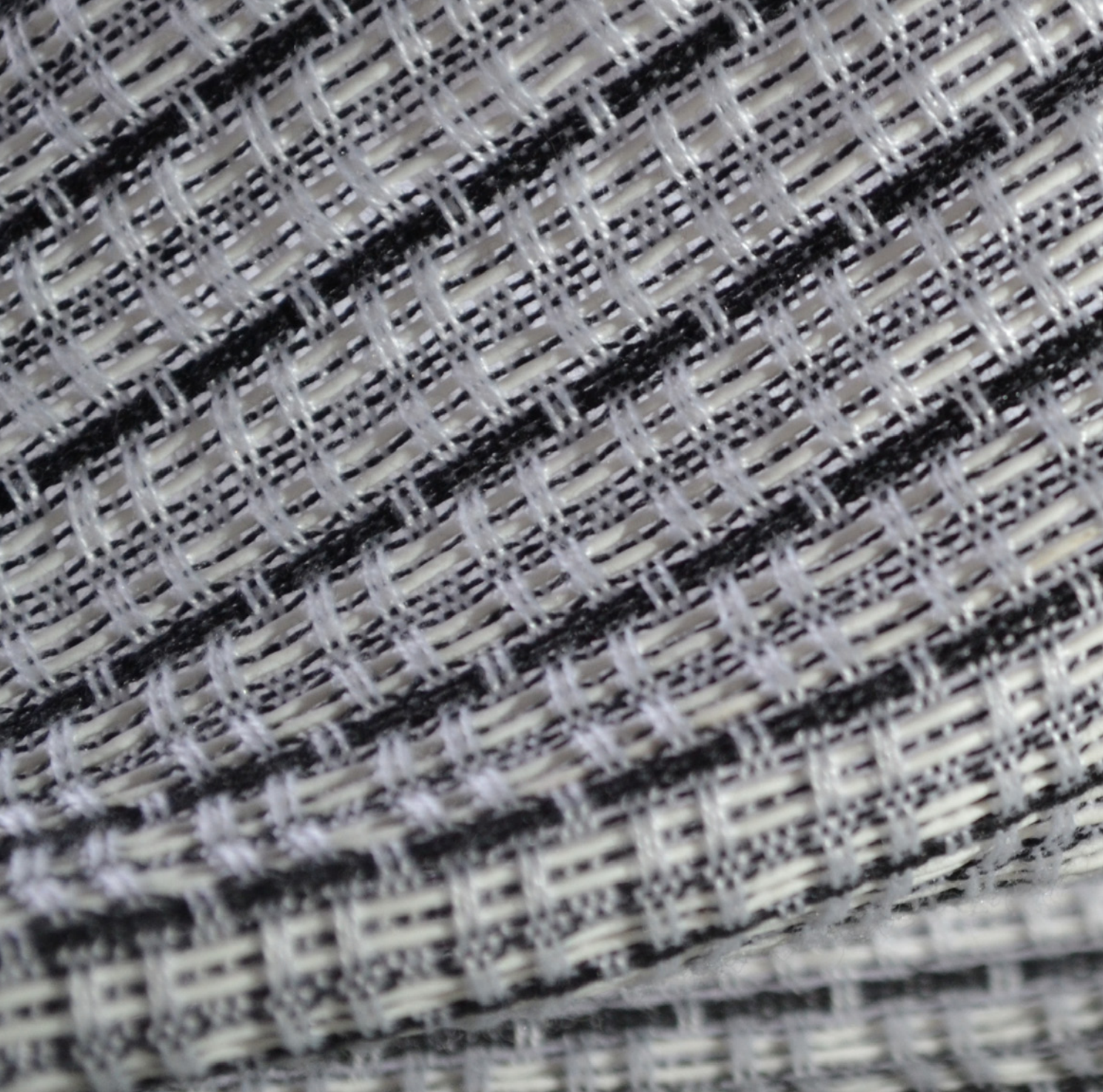
The samples Grain and Gap offer the densest surface and create at the same time a translucent effect. On the wear side the floating CoreCoat yarns are tightly bound by the black polyester yarns. While both samples are based on the same structures and materials, only the different warp colour creates

two variations. Within the sample Grain I used the contrast of black and white for a strong graphical pattern. In contrast, the design Gap has a more mixed colouring and shows a subtle strip effect.



pictures 60 & 61 - Design Grain
following page: picture 62 - Design Gap







IV SUMMARY

The aim of my thesis was to identify materials which could be suitable as a self-supporting and translucent upholstery within the field of contract textiles.

Following the definition of contract and self-supporting textiles, an overview was given of quality requirements for upholstery fabrics. These quality guidelines come from a collection of standards which are valid in the European Union. Within these norms different test methods evaluate the potential behaviour of textiles under numerous physical stresses. The results form an important component on quality information within the contract textile sector. The classification of textiles aid the process of selecting the right fabric according to its purpose. Even though the grading system within these standards is an helpful tool, it is based on laboratory testing and can only estimate a possible in-use performance. Nevertheless, it is the goal of contract textiles to aim for superior qualities able to meet the demands based on their end use.

The investigation of contract textiles and the special needs of self-supporting upholstery was followed by the introduction to an actual design case. A cooperation project with furniture designer Bogdan Chernyakevich linked the theoretical studies with a practical approach. The furniture concept of Bogdan Chernyakevich requires the development of a special upholstery fabric and demands the development of a self-supporting and translucent upholstery. Furthermore, the design follows a playful optical concept to interact with the perception of the user and thus my fabric concept

followed the idea of optical illusions. Use was made of a high contrast of dark and light in order to emphasize this concept in combination with clear geometrical patterns. For the purpose of integrating the visual concept with the self-supporting character of the fabric, existing furniture concepts were studied. This research showed a broad spectrum of how the media textile can be used. The study of self-supporting contract upholstery from the textile industry also inspired my design process.

Because the complex interplay of material and structure influenced my design to a great extent, the development of small fabric samples complemented the theoretical research. In this empirical study several materials and structures have been studied. An iterative exploration process followed from a number of initial ideas. Thereafter, the production of test samples and the discussion of findings in relation to the theoretic research followed. Finally, the selection of the most promising ideas led to further testing processes. This cyclical process narrowed the selection of materials and structures from more general assumptions to specific solutions. Finally, this led to the use of fire-retardant polyester and polyurethane yarns in combination with open woven structures. A collection of woven designs suggests possible solutions for the chair design of Bogdan Chernyakevich. These designs gave ideas on how the demands of self-supporting contract upholstery could integrate the visual concept of optical illusions. As these materials are from handwoven quality, they can not be

seen as a final product. Even though the used materials fulfil the required standards for self-supporting upholsteries, only a industrial production process could guarantee a repeatable fabric quality. This applies to the chosen structures which would require a much higher density in particular. Nevertheless, the final collection is also meant to inspire the design of self-supporting textiles. In contrast to the widespread uni-coloured warp-knitted solutions, my woven fabrics provide new ideas and inspirations to the field of contract upholstery. Moreover, these ideas could lead to a further development of the fabric concept for the chair design by Bogdan Chernyakevich.

For a realisation of this project a cooperation with an upholstery textile manufacturer would be beneficial in various ways. During my research phase many companies which I contacted for information showed great interest in my research and developments.

While the work with contract textiles implies many challenges and limitations it also offers the possibility for creative design solutions. This was a great experience within my research and design process and inspired me for further work within this field.

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picture 29 - Pugi RG, 2013. Derby [scan] (fabric sample).

picture 30 - Gabriel A/S, 2013. Omega [scan] (fabric sample).

picture 31 - K+R Textil GmbH & Co.KG, 2013. article 4716 [scan] (fabric sample).

picture 32 - Pugi RG, 2013. Basket [scan] (fabric sample).

picture 33 - Pugi RG, 2013. Tennis [scan] (fabric sample).

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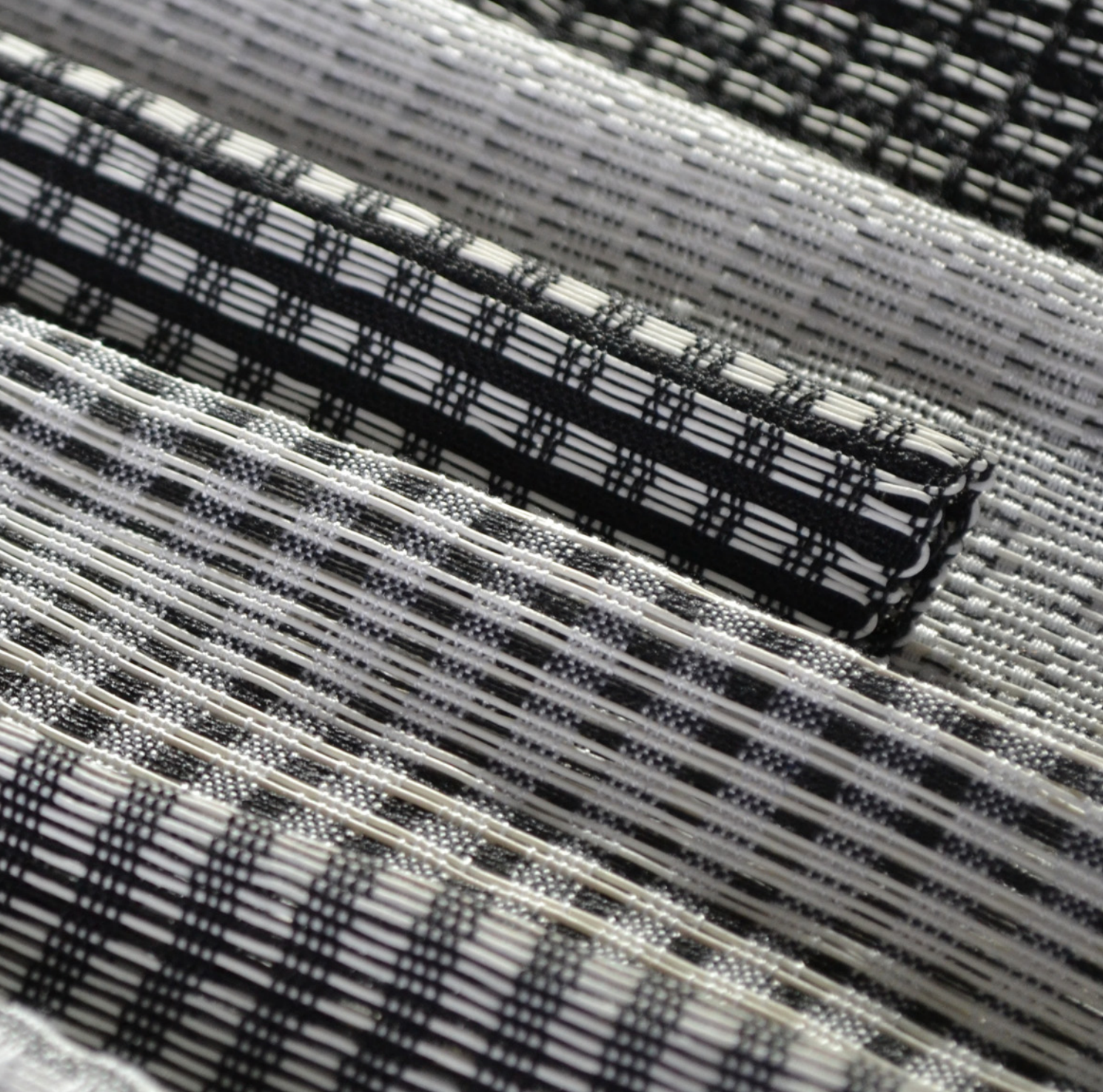
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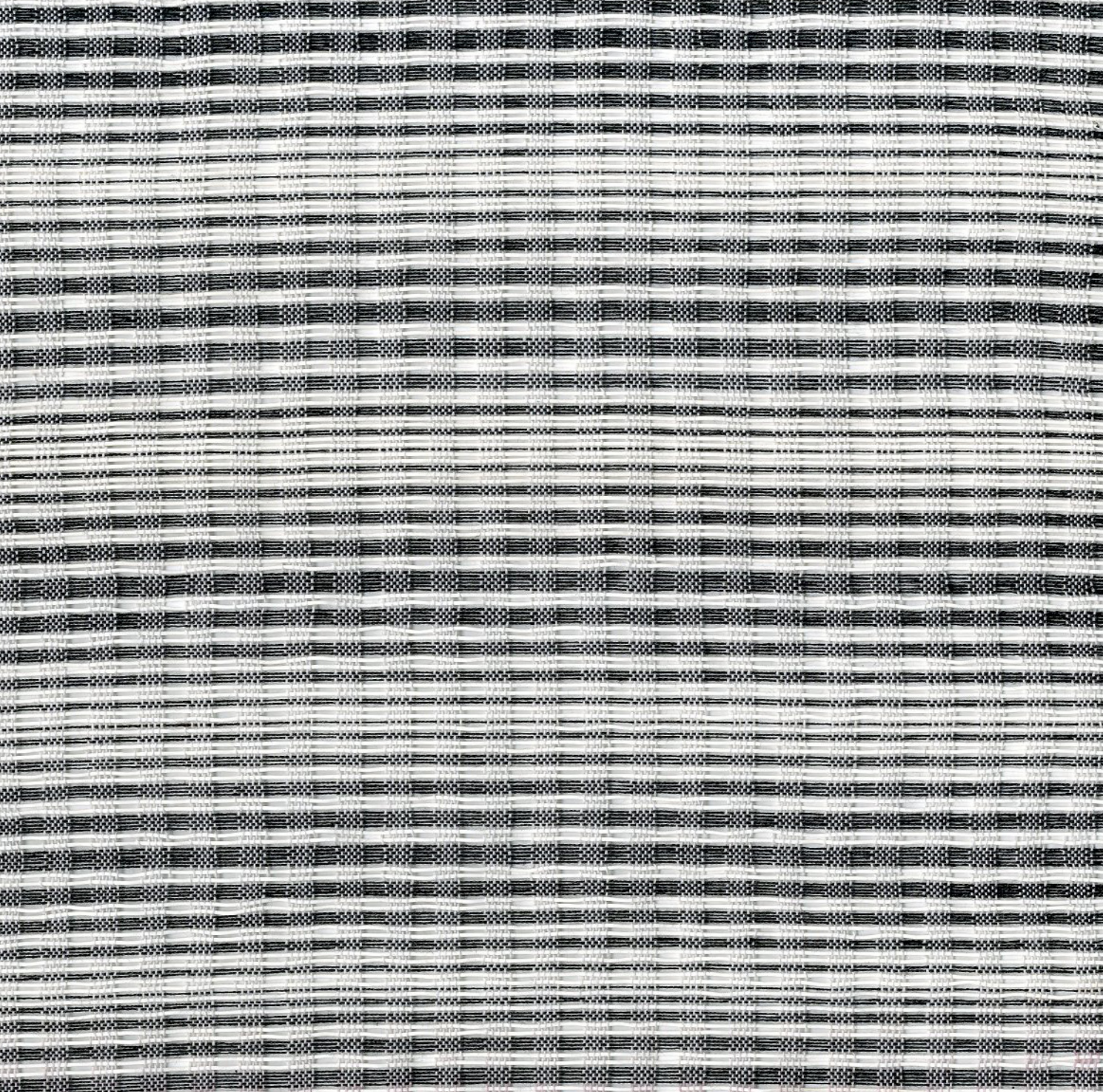
picture 46 - K+R Textil GmbH & Co.KG, 2013. SHRINX fabrics [scan] (fabric samples).

APPENDIX

A close-up, high-resolution photograph of a plaid fabric. The pattern consists of intersecting horizontal and vertical bands of different shades of gray, creating a grid-like effect. The fabric has a visible weave texture, with the threads appearing slightly raised and shadowed, giving it a three-dimensional quality. The lighting is soft and even, highlighting the intricate details of the textile.

COLLECTION





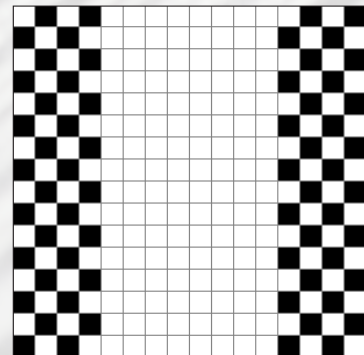
Wave

Material

warp: Trevira CS Nm 50/2

weft: Trevira CS Nm 40/2, CoreCoat PUR FR 4400 dtex

Structure: plain weave with left out warp yarns



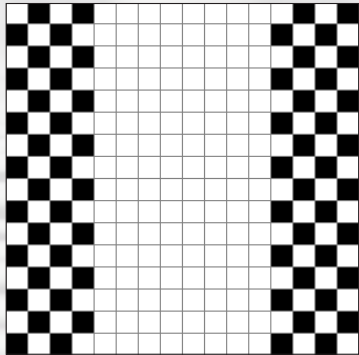
Slot

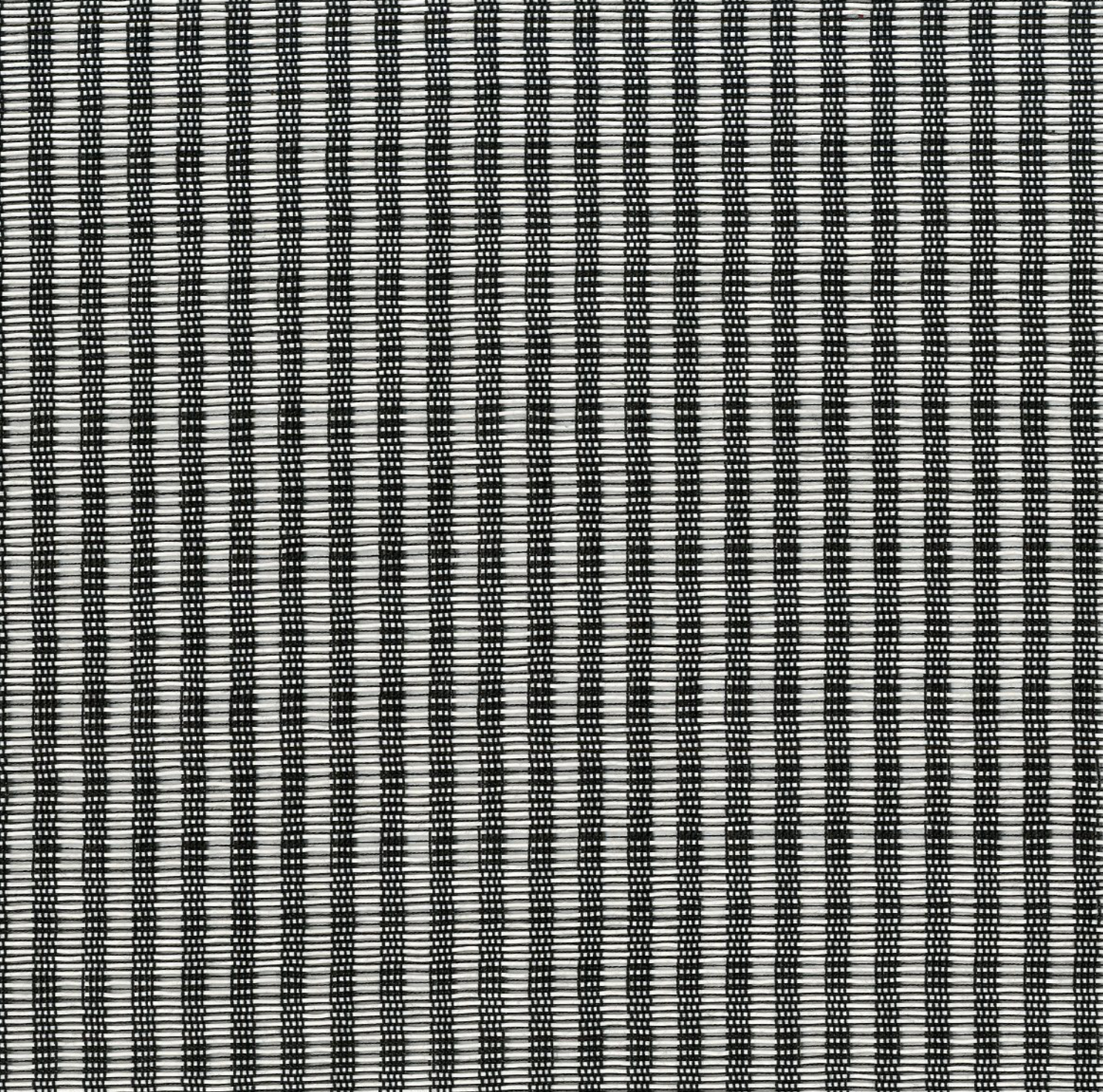
Material

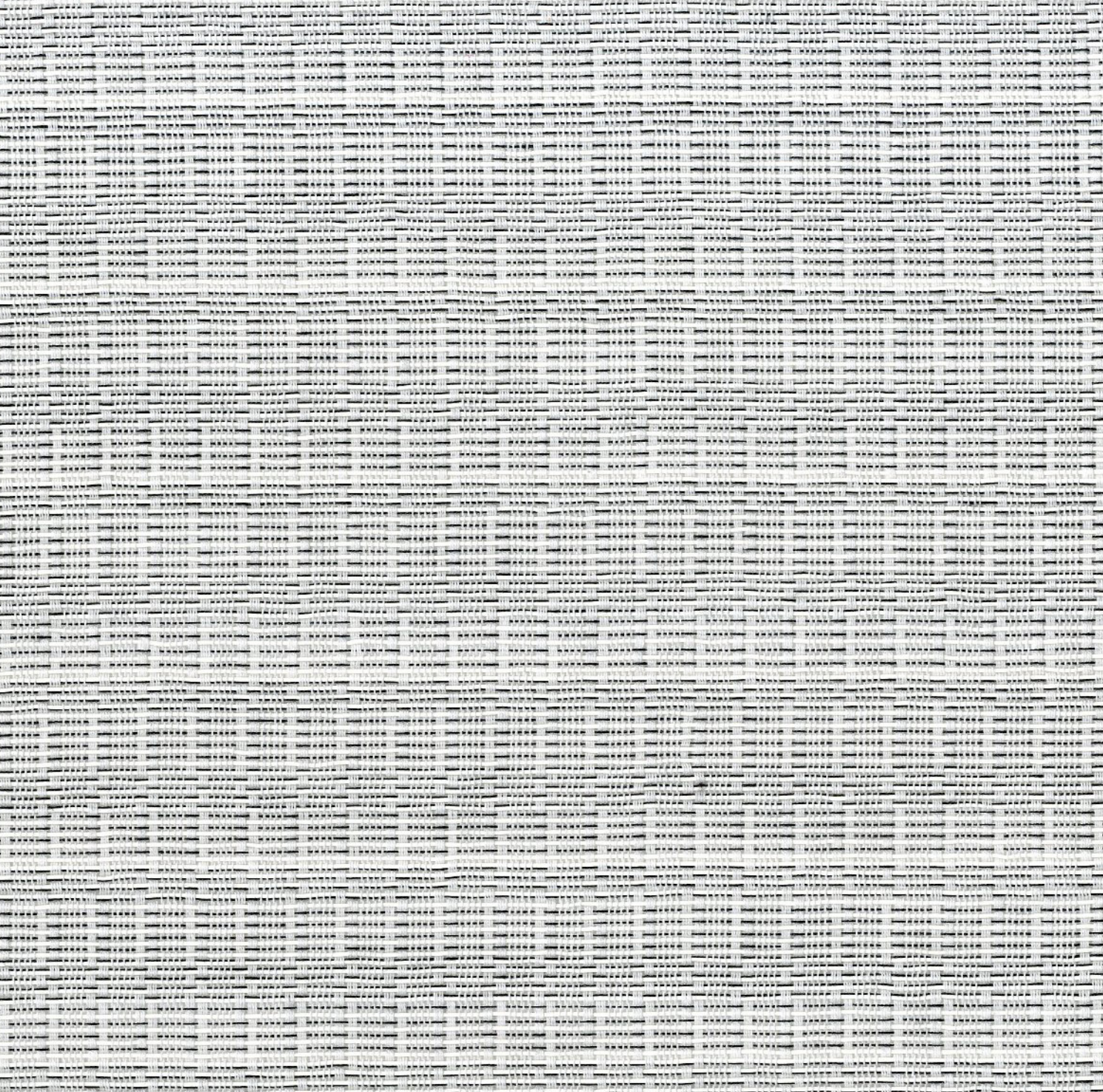
warp: Trevira CS Nm 40/2

weft: Trevira CS Nm 40/2, CoreCoat PUR FR 4400 dtex

Structure: plain weave with left out warp yarns







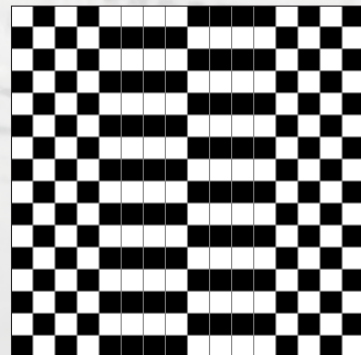
Track

Material

warp: Trevira CS Nm 50/2

weft: Trevira CS Nm 40/2, CoreCoat PUR FR 4400 dtex

Structure: plain and ribs weave



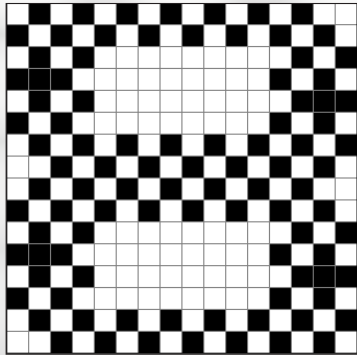
Brick

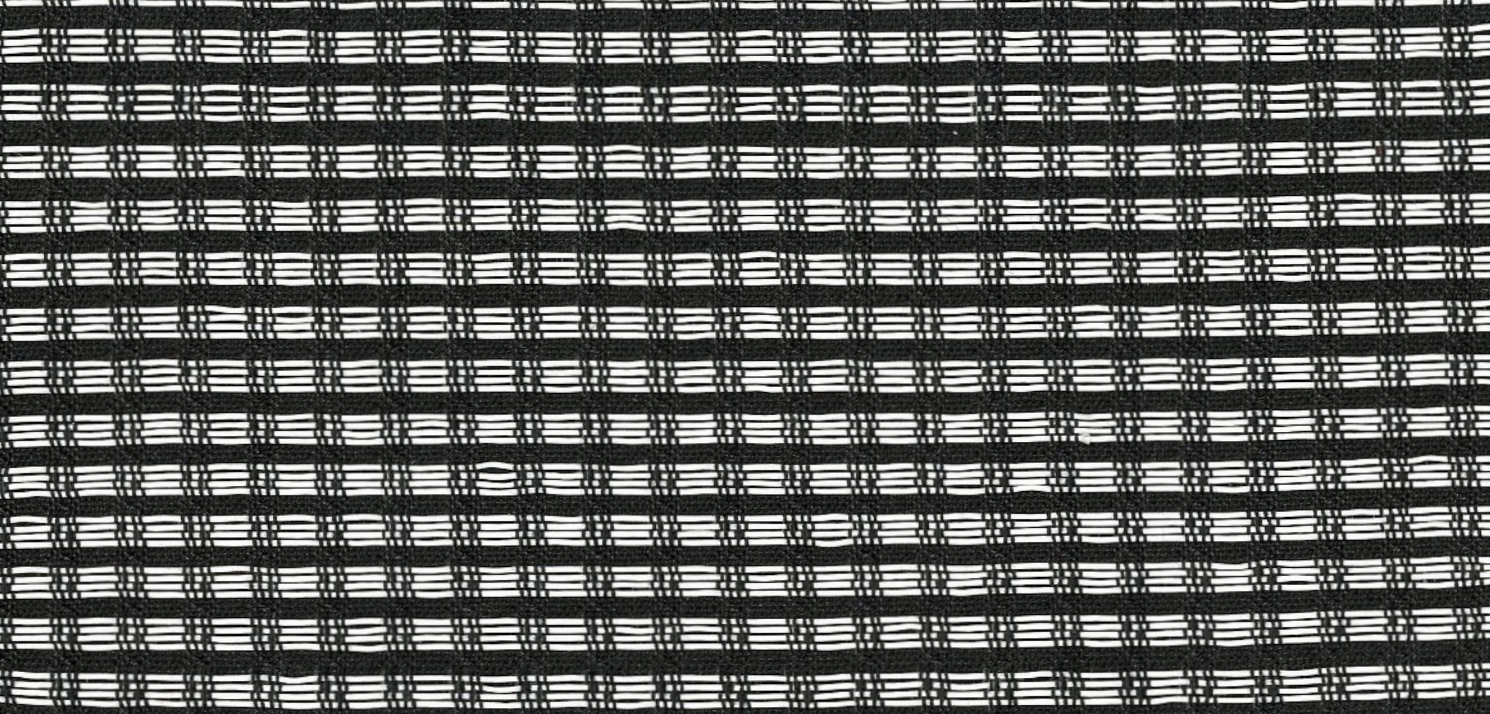
Material

warp: Trevira CS Nm 40/2

weft: Trevira CS Nm 40/2, CoreCoat PUR FR 4400 dtex

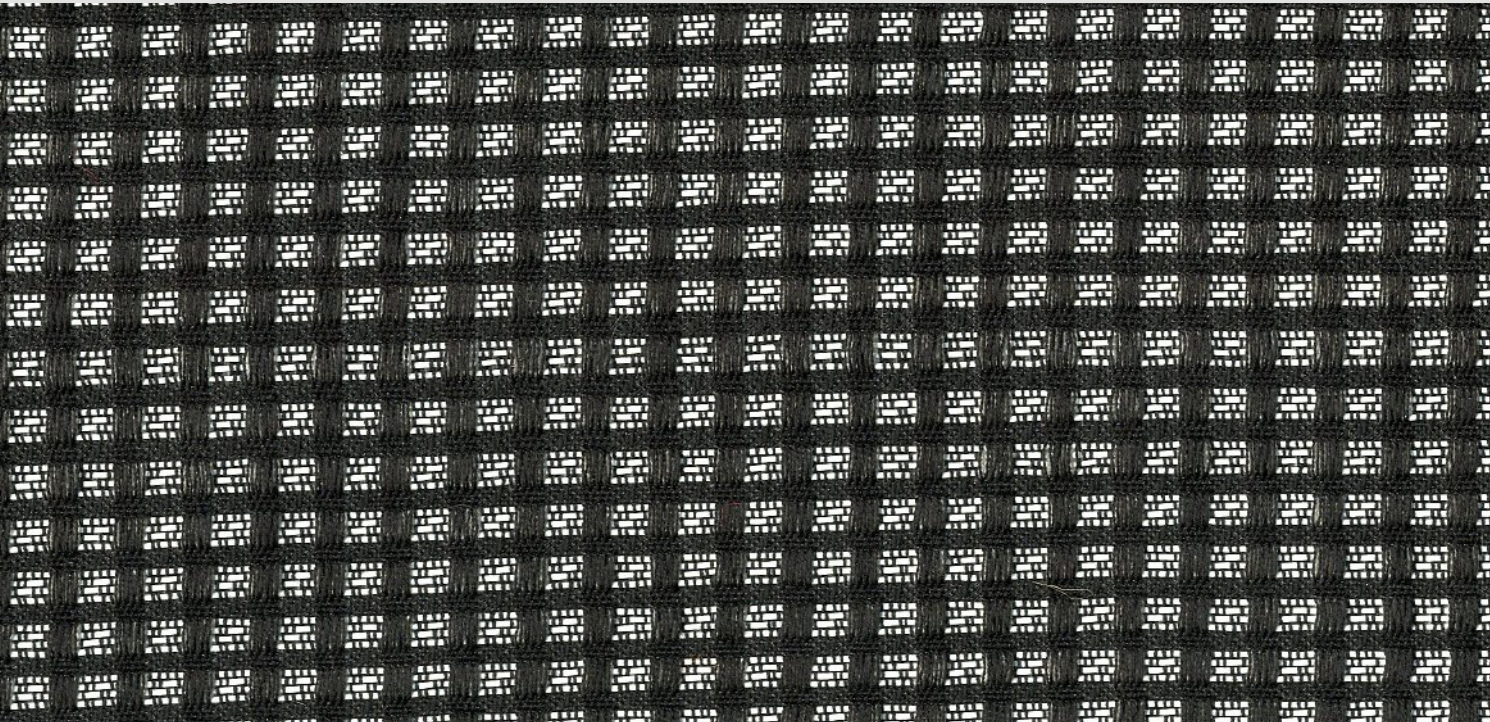
Structure: plain and mock leno weave

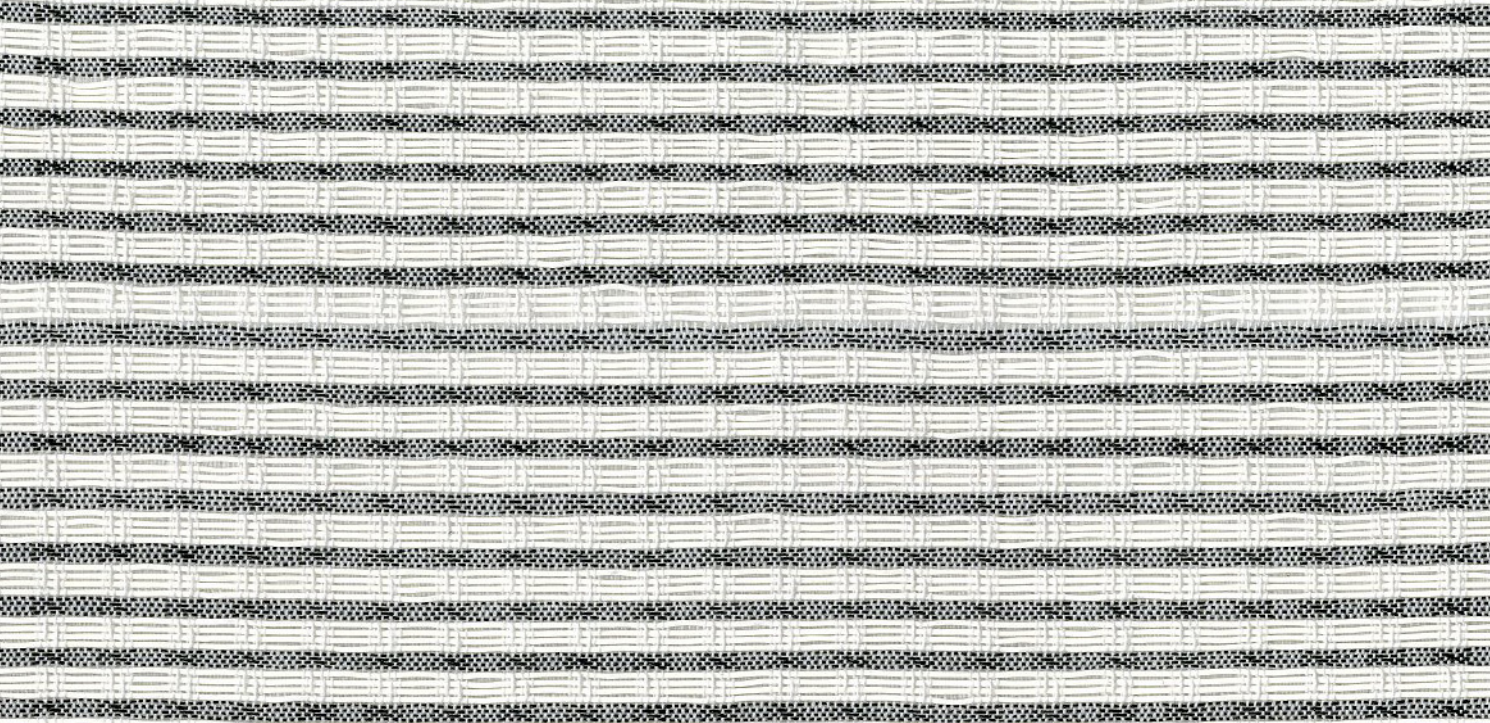




Top: Front side

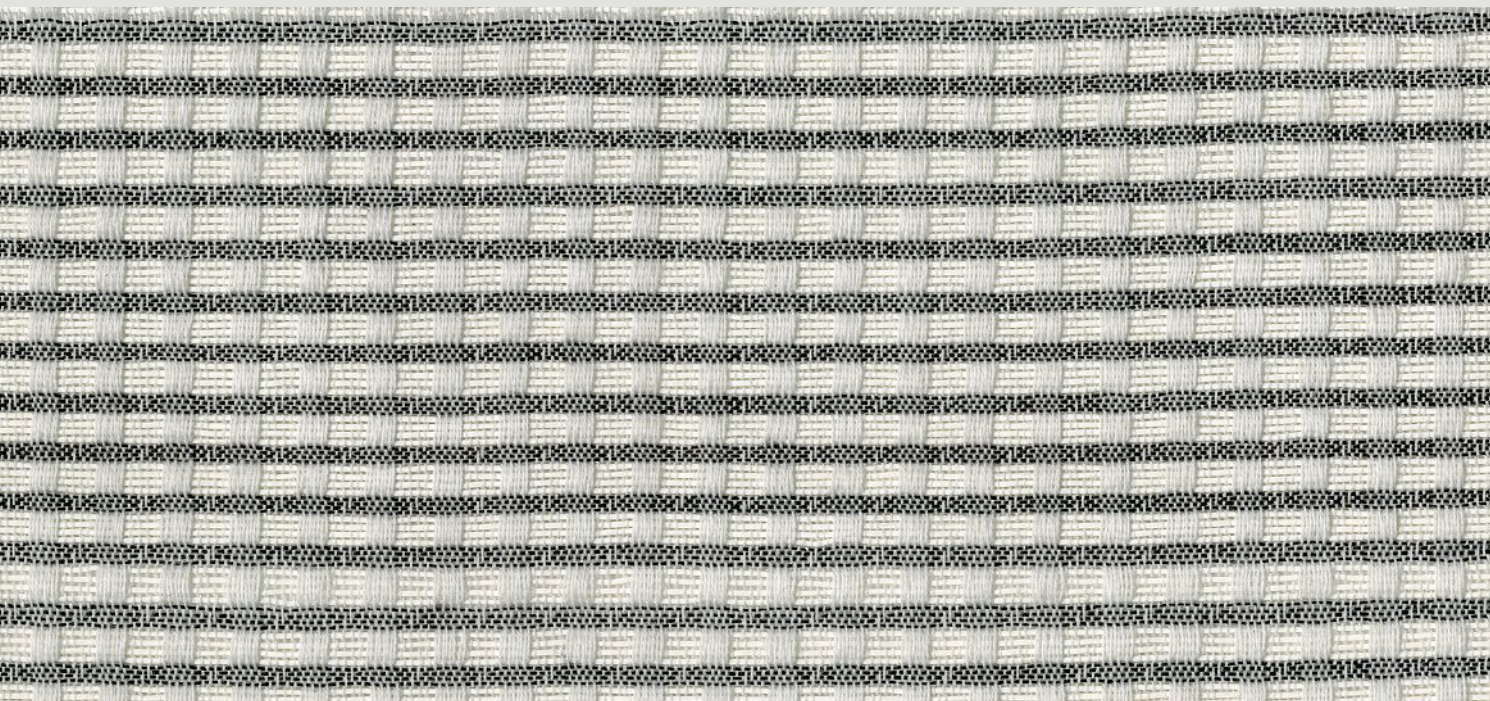
Down: Back side





Top: Front side

Down: Back side



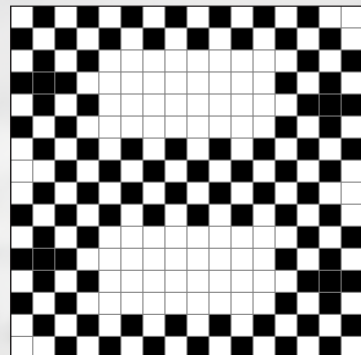
Notch

Material

warp: Trevira CS Nm 50/2

weft: Trevira CS Nm 40/2, CoreCoat PUR FR 4400 dtex

Structure: plain and mock leno weave



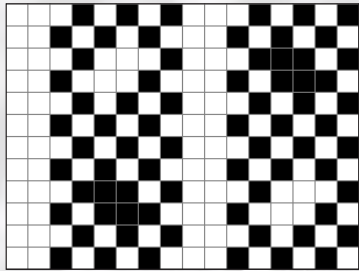
Grid

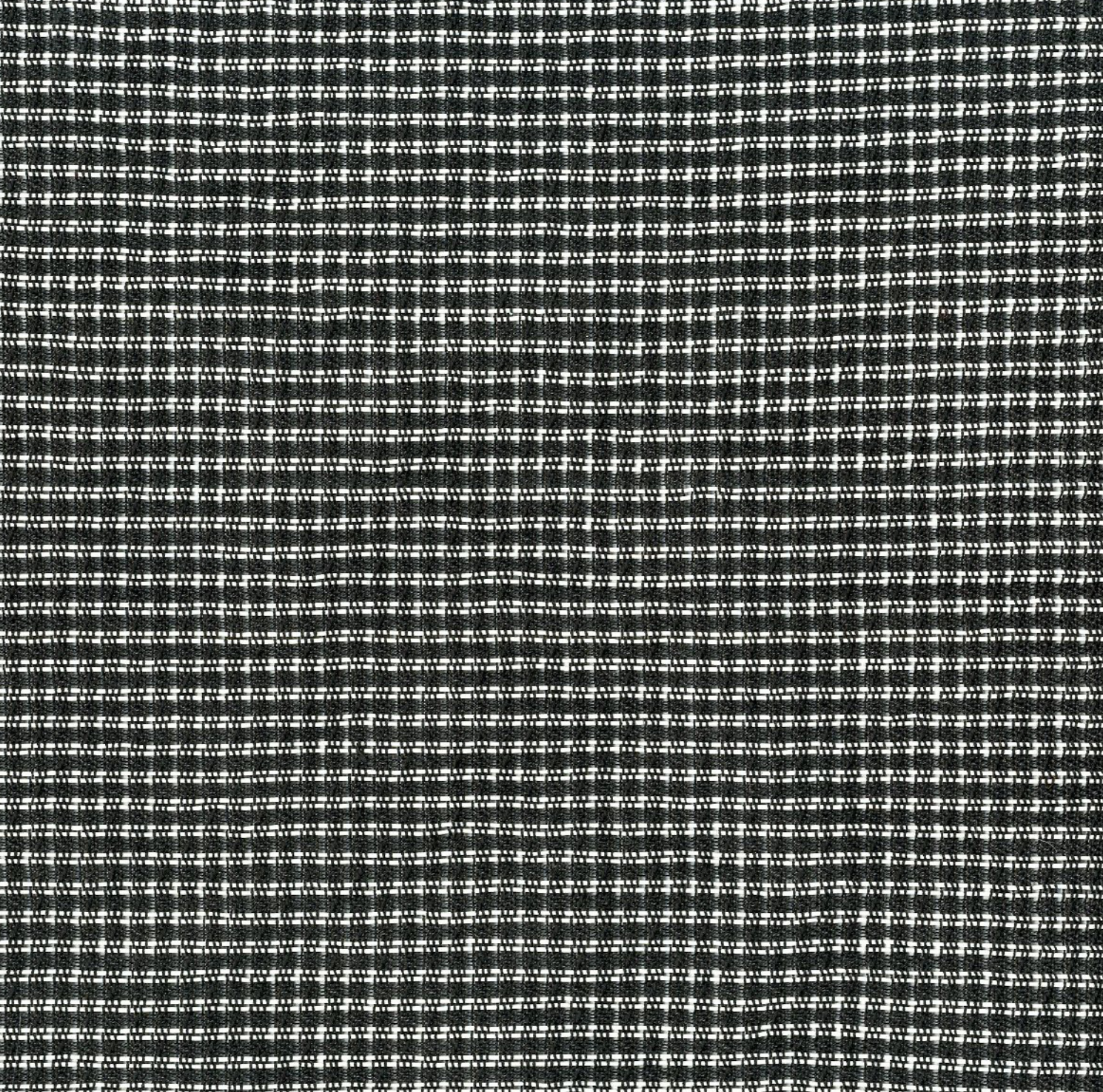
Material

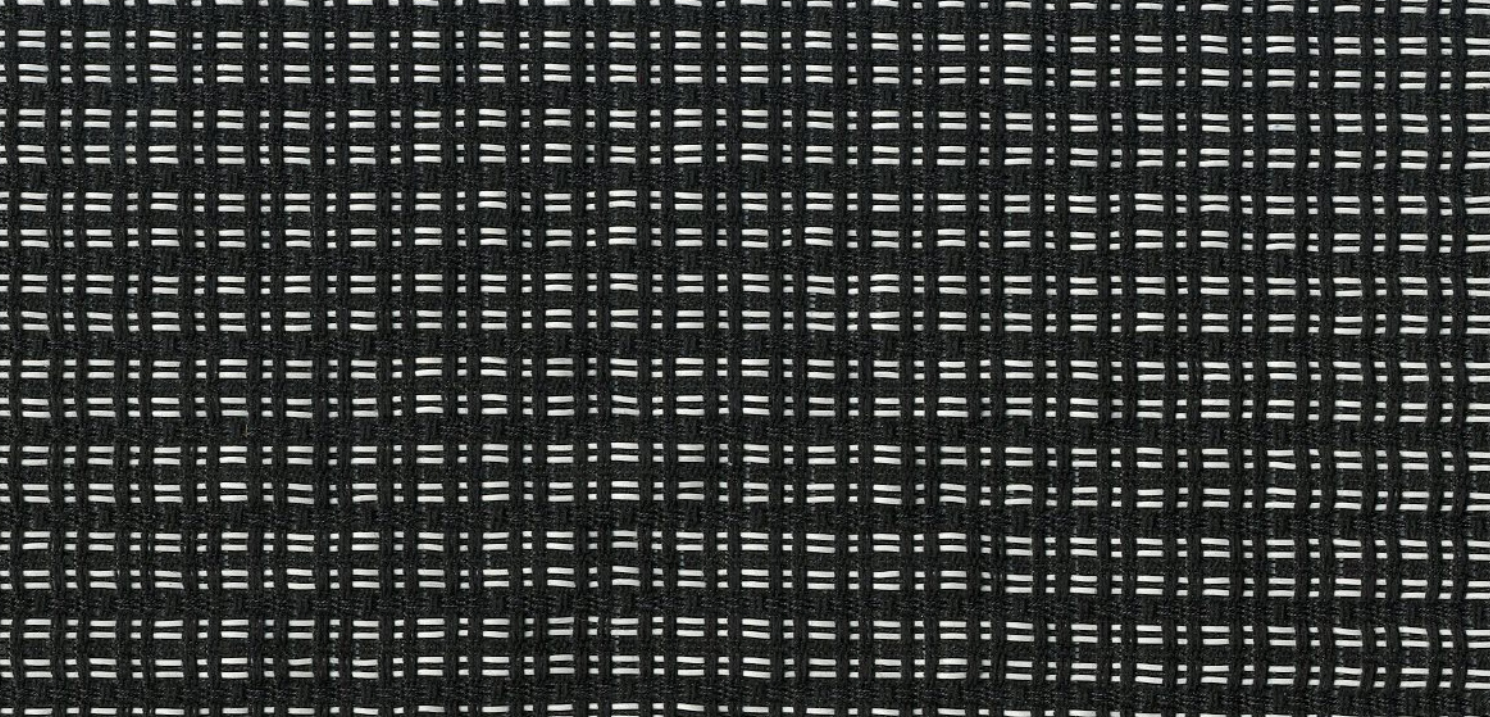
warp: Trevira CS Nm 40/2

weft: Trevira CS Nm 40/2, CoreCoat PUR FR 4400 dtex

Structure: mock leno weave with left out warp yarns

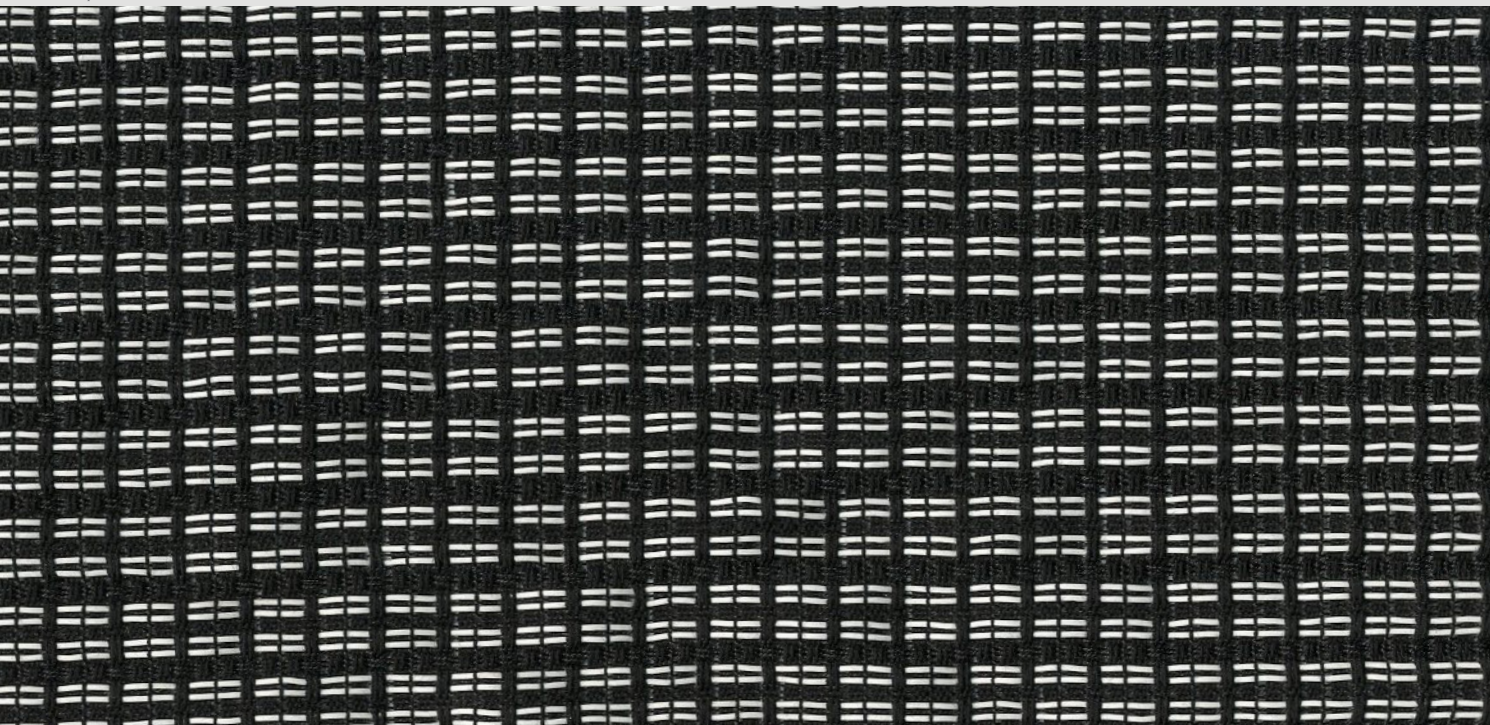






Top: Front side

Down: Back side



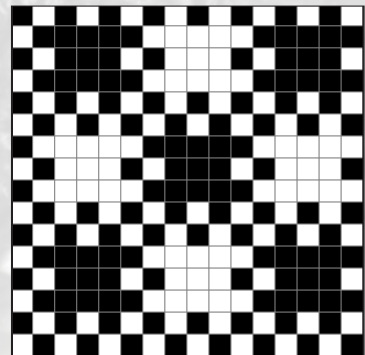
Grain

Material

warp: Trevira CS Nm 40/2

weft: Trevira CS Nm 40/2, CoreCoat PUR FR 4400 dtex

Structure: mock leno weave



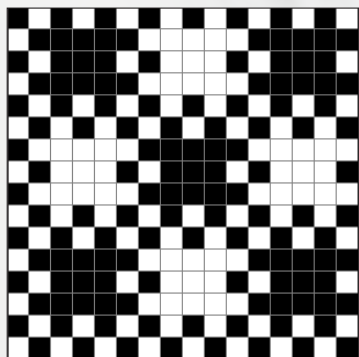
Gap

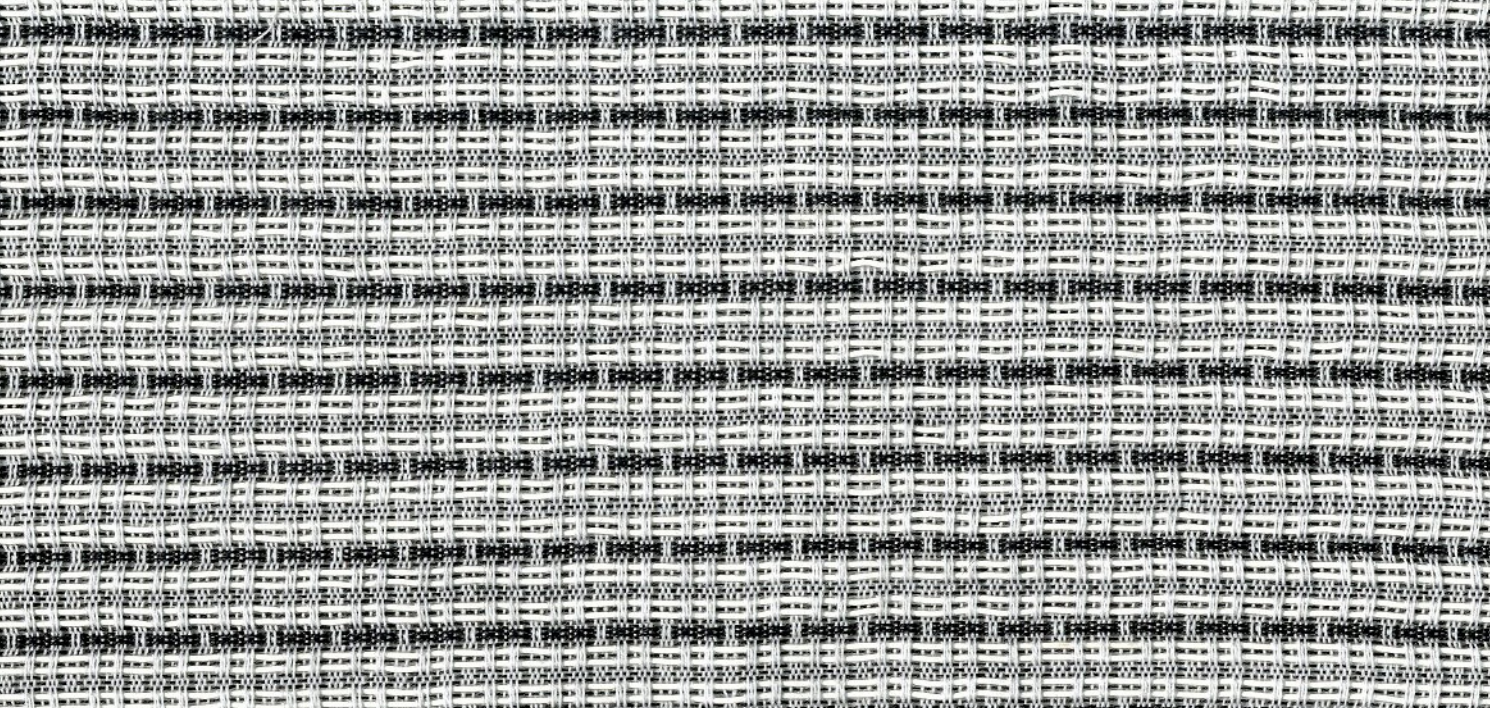
Material

warp: Trevira CS Nm 50/2

weft: Trevira CS Nm 40/2, CoreCoat PUR FR 4400 dtex

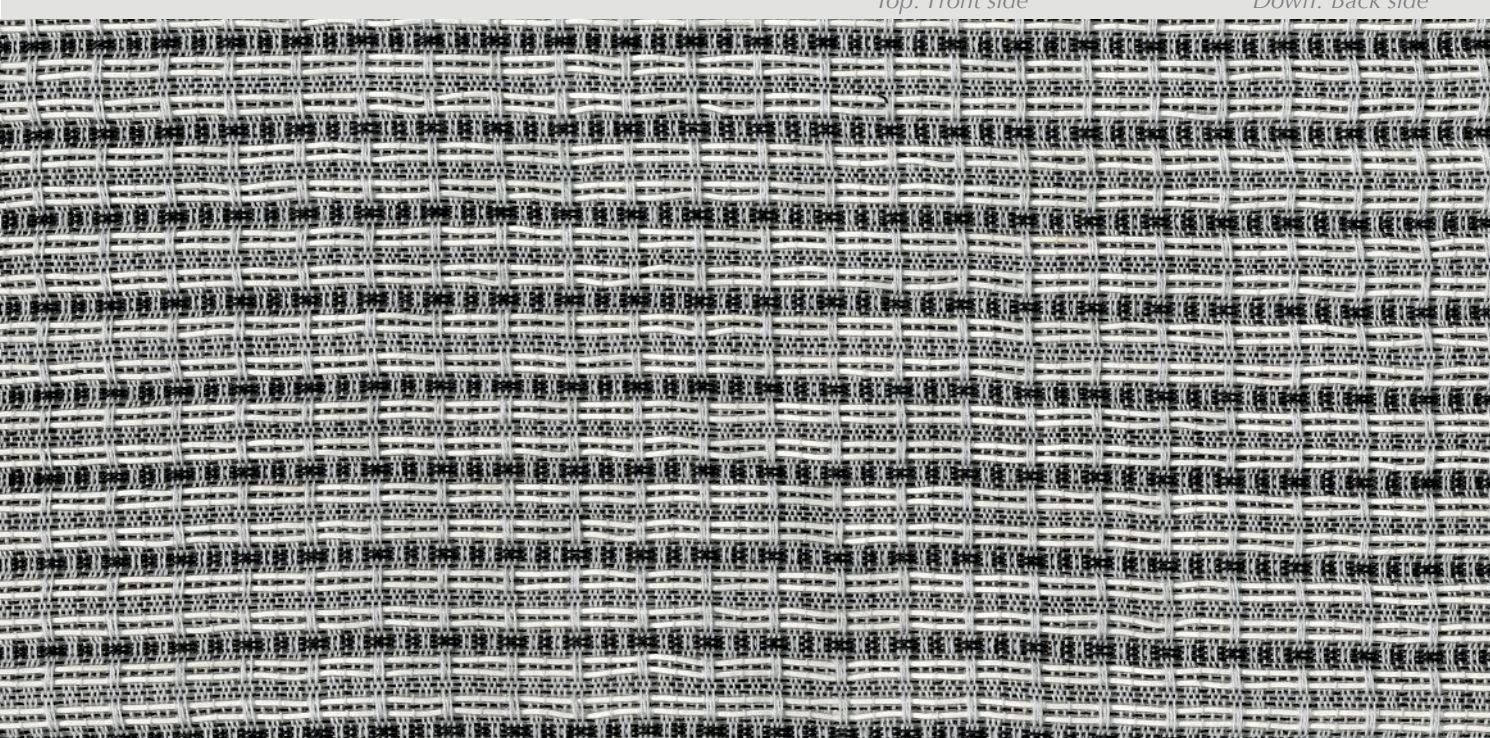
Structure: mock leno weave





Top: Front side

Down: Back side



COMPANY SUPPORT - CONTACT INFORMATION

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